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System-targeted management of training in the field of judo

UDC 796.853.23



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Abstract

Objective of the study is to develop a concept of system-targeted management of long-term athlete preparation in judo.

Methods and structure of the study. The research incorporated systemic, person-centred, activity-based, technological, differentiated, and integrative approaches, providing a comprehensive examination of the sports training process as an integral pedagogical system.

Results and conclusions. The provisions of the concept have been substantiated, revealing the essence of long-term judo training as a managed, open, and dynamically developing system oriented towards the achievement of stage-specific target indicators of sporting mastery. An original concept has been formulated, based on the systematic elevation of the level of sporting mastery through the attainment of target benchmarks at each stage of long-term preparation and the technologisation of the training process. It has been established that the effectiveness of preparation is determined by the coherence of pedagogical influences, the individualisation of the training process, consideration of the morphofunctional and typological characteristics of athletes, and the continuity of the stages of sporting improvement.

The results obtained may be used in the development of sports training programmes for judoists, the improvement of the selection system, and the management of the training process.

Keywords: *methodology, preparation, management, athletes, judo.*

Introduction. In recent decades, a trend has been observed in Russia towards a reduction in the number of judoists at the stage of elite sporting mastery [8]. One of the key reasons for this situation, according to specialists [5, 7], is the absence of system-targeted management of long-term sports training in judo, which leads to a large dropout of talented judoists who do not see clear goals before them, the achievement of which should be supported by systematic and consistent pedagogical work.

Understanding this prompts researchers to conduct corresponding studies in the field of the theory and methodology of long-term sports training [1] and sport selection [2]. However, while in game sports, owing to their greater popularity, this problem is being addressed, in judo the accumulated knowledge in these areas has not yet been considered from the perspective of system-targeted management of long-term sports training.

Analysis of the information accumulated to date on the research problem showed that the formation of integral knowledge is based on a key idea, for which the special term "concept" is used in science [9]. From the standpoint of philosophy, a concept is a system of understanding (from the Latin *conceptio*), encompassing a complex of views on the object of research; a specific way of understanding the object (or phenomena associated with it) and its (or their) interpretation; a guiding intent that determines the pathways for resolving the problematic situation.

Objective of the study is to develop a concept of system-targeted management of long-term athlete preparation in judo.

Methods and structure of the study. The research incorporated systemic, person-centred, activity-based, technological, differentiated, and integrative approaches, providing a comprehensive ex-



amination of the sports training process as an integral pedagogical system.

Results of the study and discussion. The application of the systemic approach [3] made it possible to identify and study the general organisational aspects of the research, to determine and correctly formulate the scientific problem.

The systemic approach was also used for the purpose of systematising the accumulated experience on the studied problem and determining pathways out of the current situation. The systematised body of knowledge about the subject of research led to the development of technological support for the process of improving the sporting mastery of judoists in the form of a special model.

It is well known that at the foundation of the systemic approach lies the concept of "system" [4], which is a combination of multiple elements (parts) possessing structure and hierarchy, in which the constituent components are in relationships and connections with one another, perform a specific function, which forms a certain integrity and unity.

At the same time, long-term sports training is considered in classical works as a system based on a specific management mechanism that includes setting goals, forecasting their achievement, modelling, planning and programming various aspects of the training process, monitoring indicators of sporting mastery, and correcting pedagogical influences. At the same time, the effectiveness of the sports training system is presented in the form of achieving target indicators and is defined as the correspondence of the actual preparedness of athletes with their planned mastery characteristics at all stages of sports training, taking into account various periods of the annual cycle, which indicates the technologisation of this process [3].

Since the sports training system for judoists is a pedagogical system, its effectiveness, according to some authors [6], largely depends on the interaction of coaches and athletes, in which coaches offer training influences, and athletes, by carrying them out and recovering between training sessions, strive to achieve a cumulative effect and improve technical and tactical skills in their chosen sport.

The application of the systemic approach in our research made it possible to establish the key properties possessed by the sports training system for judoists. These properties are: integrity, substantiveness, structurality, hierarchicality, functionality, and interconnection with the environment. Substantiveness is repre-

sented by pedagogical influences that coaches offer judoists for implementation on the tatami, in the sports hall during training sessions and competitions in the form of plans and training programmes. Structurality in the system of stage-based training is manifested in the varying influence of sports training factors on the results of judoists. Among these factors, physical qualities, functional systems, and competitive activity skills are distinguished. At the same time, the factor structure has a variable character, conditioning a different hierarchy of factors at each stage of long-term sports training in judo. Functionality is conditioned by the competence of coaches and athletes. Interconnection with the environment is manifested in the fact that judo is part of the system of sports, representing an educational and upbringing process.

In the context of system-targeted management of sports training for judoists, it is important to note that purposefulness is understood as the process of defining a goal, as well as verifying its achievability, based on the current capabilities of the judoist's body. In this connection, researchers identify a number of requirements for the person managing sports training, in terms of understanding that the goal must be specific, measurable, difficult to achieve but realistic, and must provide for the possibility of monitoring [4].

At the same time, the system of long-term sports training for judoists is an open, developing system characterised by dynamism, which is understood as the ability to change its state under the influence of external and internal factors. It is important to note that the system under consideration possesses another important property – stability, i.e. the ability to preserve the structure of elements that function for the necessary time, interacting with and withstanding internal and external influences.

The person-centred approach was applied for the purpose of studying the influence of various conditions and factors of sports training on the personality of the athlete [3]. As already noted, the foundation of the training process is the relationship between coaches and athletes, in the course of which specialists, by their own example, orient their charges towards the achievement of the target benchmarks of the author's concept. In the process of sports training, it is important to take into account the individual, age-related, and personal characteristics of the subjects, which ensures more effective development and self-realisation of the athlete's personality, expressed, among other things, through the level of sporting mastery in judo.



The activity-based approach [3] made it possible to study the structure of training and competitive activity in judo, as well as the direct role of judoists in this lengthy process, in which they, under the influence of pedagogical impacts, overcoming themselves, strive to solve the tasks set before them, which conditions their gradual transformation into active participants in this process. The application of the activity-based approach is associated with an orientation towards the achievement of a specific result. At the same time, the activity of judoists is organised in such a way that the coach provides athletes with the opportunity to learn the capabilities of their own body and to reflect on their leading and lagging physical qualities, technical skills and abilities.

The application of the technological approach [3] in the concept being developed made it possible to create a model of its implementation in the conditions of sports training for judoists through the sequential implementation of key modules: conceptual, diagnostic-potential, content-programmatic, and control-corrective.

The differentiated approach [7] was applied for the implementation of important components of the studied system of long-term sports training for judoists, which included the division and classification of pedagogical influences on athletes taking into account their weight group and category, as well as their typological characteristics of physical and technical-tactical preparedness.

The integrative approach [3] ensured the introduction of effective means, methods, techniques, technologies and conditions successfully implemented in other areas of scientific knowledge, with the aim of ensuring the continuous growth of the sporting mastery of judoists and increasing the competitive environment in judo. In the implementation of this approach, the key criterion for the proposed influences was the sporting result, which, however, could be expressed through the assessment of the most important indicators of preparedness and the condition of judoists.

The use of scientific-methodological approaches made it possible to clearly present the concept of the present research, which can be expressed as follows: systematic improvement of the sporting mastery of judoists through the achievement of stage-specific target indicators based on continuous long-term pedagogical influences, implemented in the form of a pedagogical technology taking into account the genetic predisposition to a weight category, the type of competitive preparedness, the features of morpholog-

ical changes in the body, the rates of development of motor qualities, and an orientation towards the leading factors of sporting achievement in judo.

Conclusion. Thus, a concept of system-targeted management of long-term sports training in judo has been developed, which conditioned the expediency of technologising the key idea of the research in the process of stage-based sports training of judoists.

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The methodology of organising the training of middle-distance runners aged 15–17 years in an annual training cycle

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Abstract

Objective of the study is to develop a methodology for organising the training of female middle-distance runners aged 15–17 in the macrocycles of an annual training cycle and to substantiate its effectiveness.

Methods and structure of the study. On the basis of an analysis of literature data and the authors' own research results, a methodology was developed for organising the training of female middle-distance runners at the stage of advanced specialisation in an annual training cycle, which includes the projected dynamics of indicators of athletes' special preparedness, as well as the rational distribution of the volume of the main training means in the autumn-winter and spring-summer macrocycles. The methodology was tested in the training process of 13 female middle-distance runners aged 15–17, and its effectiveness was assessed by the magnitude of improvement in competitive results and indicators in control tests compared with the previous year.

Results and conclusions. The character and dominant orientation of training influences for female middle-distance runners at the stage of advanced specialisation were determined by month of the preparation macrocycle. It was shown that load parameters in terms of volume and orientation, as well as content and character, must correspond not only to the strategic objectives of athletes' preparation in the macrocycle but also be commensurate with the biorhythmological patterns of their body's functioning in the mesocycle. The results of the pedagogical experiment demonstrated the productivity of the developed methodology and the expediency of an individual approach in the implementation of the training process.

Keywords: methodology, female middle-distance runners, 15–17 years, macrocycle, training means, individual approach.

Introduction. Ensuring the optimal level of readiness of a female athlete for the main competitions is possible only on condition of the effective use of rational forms of constructing training loads in the annual cycle and its individual structural formations [1, 2, 5]. At the same time, the organisation of the annual macrocycle is a kind of "roadmap" for the athlete's preparation for the planned time cycle, which is conditioned by determinants that determine the effectiveness of their adaptation to the means and methods of influence characteristic of the given sport [6].

As Yu.V. Verkhoshanskiy [1] emphasised, the study of adaptation mechanisms or factors determining the special work capacity of an athlete "in general", without taking into account the specifics of their improvement within the framework of the real temporal structure of

the training process, may be of a certain cognitive interest, but may not carry any tangible practical benefit. Therefore, the prerogative for coaches should be the establishment of the fundamental orientation of the training process, which will make it possible to determine the predominant character of the application of particular training influences at each structural unit of the annual preparation cycle, taking into account the individual characteristics of the athlete, and the final expression of the degree of rationality of training process management and the objective characteristic of its productivity will be the sporting result shown by the athlete at the main start of the season.

Thus, the development of rational ways of combining the structural units of the annual cycle of preparation of female middle-distance runners into a single



system, taking into account the specific stage of long-term improvement, the interrelationship of prescribed training influences and the inherent individuality of the athlete, is a pressing problem.

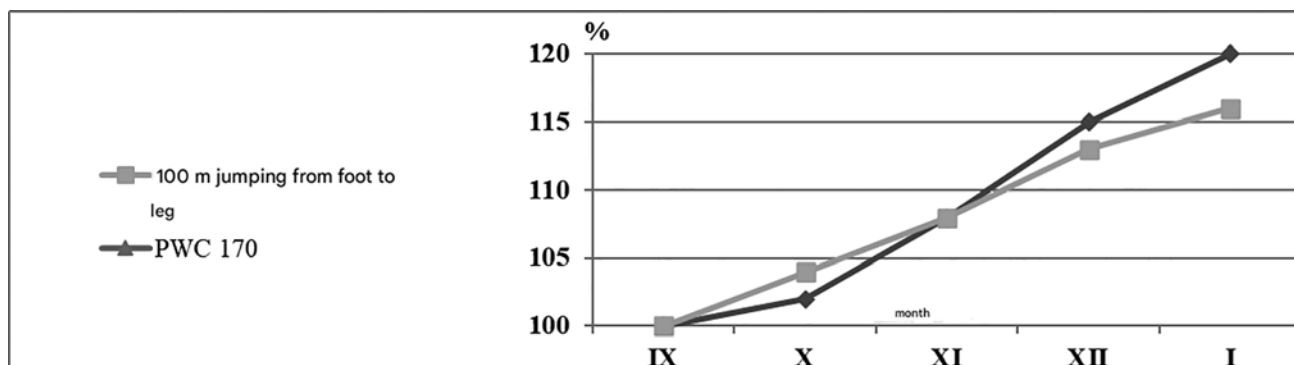
Objective of the study is to develop a methodology for organising the training of female middle-distance runners aged 15–17 in the macrocycles of an annual training cycle and to substantiate its effectiveness.

Methods and structure of the study. On the basis of an analysis of literature data [3, 5, 7] and the authors' own research results [4, 8], a methodology was developed for organising the training of female middle-distance runners at the stage of advanced specialisation in the annual training cycle. The methodology includes the projected dynamics (model) of indicators of athletes' special preparedness, represented by results in the jump test and data on physical work capacity (PWC_{170}), as well as the rational content of the main training means and the distribution of their volume, taking into account the specifics of the prepa-

ration of female runners in the autumn-winter (Fig. 1) and spring-summer (Fig. 2) macrocycle.

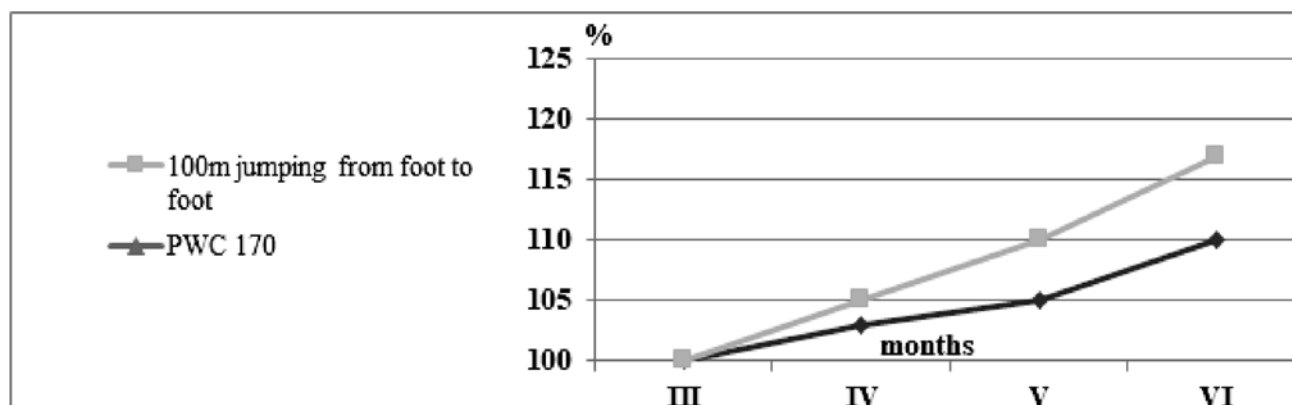
The PWC_{170} test ($\text{kgm}\cdot\text{min}^{-1}$) was used to determine the aerobic component of the physical work capacity of the athletes, and the result (conventional units) in covering a 100-metre distance with alternating-leg bounding jumps (the product of the number of jumps and the execution time) assessed the special strength preparedness of 800 m runners. The target objectives of the macrocycles provided for changes in the condition of the athletes by the required magnitude by the first and second competitive periods. This was achieved with the help of a specific programme of training influences (Table 1), in which the volume of the main means of preparation for the specific macrocycle and its distribution by months (as a percentage of the total amount in the macrocycle, taken as 100%) are presented.

The effectiveness of the implementation of the training methodology was ensured by regular (1–2 times per mesocycle) control assessment of the current state of the athlete's potential, comparison of its



Training influences (intensity zones)	Volume per macrocycle	Approximate load distribution by month, in % of total volume per macrocycle				
		IX	X	XI	XII	I
Aerobic recovery, km	987.6±134.7	35	27	15	14	9
Aerobic developmental, km	316.1±71.6	31	25	18	16	10
Mixed aerobic-anaerobic, km	97.4±14.1	33	6	15	6	3
Anaerobic glycolytic, km	18.4±3.3	-	-	26	38	36
Anaerobic alactic, km	4.9±1.2	-	-	22	33	45
Jumping exercises, km	8.5±2.9	37	22	17	15	9
General physical preparation, hours	34.1±11.6	32	29	25	10	4

Figure 1. Methodology of organising the training of female middle-distance runners in the autumn-winter macrocycle: above – projected dynamics in the macrocycle of the physical work capacity indicator and jump test result (in %); below – main training means and their distribution in the macrocycle as a percentage of the total (100%) volume



Training influences (intensity zones)	Volume per macrocycle	Approximate load distribution by month, in % of total volume per macrocycle			
		III	IV	V	VI
Aerobic recovery, km	736.1±111.5	48	30	16	6
Aerobic developmental, km	208.9±19.9	44	27	20	9
Mixed aerobic-anaerobic, km	80.8±10.3	39	26	18	17
Anaerobic glycolytic, km	21.8±6.7	9	17	36	38
Anaerobic alactic, km	5.3±1.1	-	29	30	41
Jumping exercises, km	8.5±1.7	34	29	27	10
General physical preparation, hours	34.1±7.2	39	32	26	3

Figure 2. Methodology of organising the training of female middle-distance runners in the spring-summer macrocycle: above – projected dynamics in the macrocycle of the physical work capacity indicator and jump test result (in %); below – main training means and their distribution in the macrocycle as a percentage of the total (100%) volume

real characteristics with the model ones, and correction, if necessary, of the training programme.

Results of the study and discussion. In the sporting practice of female runners at the stage of advanced specialisation, a predominantly 2-cycle periodisation, consisting of two macrocycles, is already used. In turn, the latter consist of mesocycles – a kind of "building blocks" that constitute the stages and periods of the annual cycle [5, 6].

Thus, the main mesocycles in the preparatory period are considered to be base mesocycles, which include 10–12 microcycles (in the autumn-winter macrocycle this is October-December, in the spring-summer – March and April) [3, 5, 7]. The programme of these mesocycles provides for conducting dominant work aimed at increasing aerobic-anaerobic capacities, developing physical qualities, and establishing the technical, tactical and psychological preparedness of the runners. The training programme already includes the use of diverse means, with their significant impact on the athletes' bodies [1]. The role of multi-jumps, jumps and uphill running increases.

In the control-preparatory mesocycle (in the autumn-winter macrocycle this is January, in the spring-summer – May), the emphasis is placed on increasing speed abilities and special endurance. Considerable attention is given to strengthening the muscles of the legs, abdominal press and back, developing flexibility, practising motor switching, improving the coordination structure of running movements and developing tactical elements.

In the competitive periods (February and June-August), the runners need to achieve the highest sporting results within the pre-planned timeframes of the major competitions. For this purpose, mainly individualised running training influences in the anaerobic glycolytic and anaerobic alactic zones of energy supply are used.

In the transition period, training sessions restoring the physical and psychological work capacity of the athletes should predominate. The main content of the sessions here comprises general physical preparation means used in an active rest mode: prolonged slow running, exercises with weights, swimming, sports games, and various types of throwing athletic implements.



When addressing organisational issues in the preparation of girls and women, one cannot disregard the results of numerous studies [8, 4, 7, 9–11], which indicate that training mesocycles should be constructed so that the content, means and methods of influence in each microcycle fully correspond to the level of work capacity, individual capacity for recovery, as well as the physical, functional and psychological state of the athlete, which are specific to her in one or another phase of the ovarian-menstrual cycle (OMC). Therefore, the training mesocycles were structured by us in accordance with the number of OMC phases and consisted of five microcycles, each of which differed in the orientation of sessions in accordance with changes in the functional state and special work capacity of the athletes in certain phases of the menstrual cycle. Following this scheme of constructing the training process promoted the interrelationship between the dynamics of training influences and the rhythmic wave-like changes in the functional state of the specific athlete's body.

The implementation of the developed methodology for organising the training of female runners in the macrocycles of the annual training cycle, individualised in accordance with the biorhythms of the athletes' bodies, showed its high productivity. Thus, the sporting results of the 13 athletes who took part in the experiment improved, on average, in the 800 m race by 4.1 s ($p < 0.05$), the indicators in jump tests and physical work capacity (PWC170) increased, respectively, by 7.8 and 8.9%, compared with the previous year. At the same time, thanks to the synchronisation of the preparation structure and the OMC phases of the athletes, the effectiveness and productivity of competitive activity increased, the training process became more manageable, and the result obtained was achieved without increasing the volume and intensity of training loads.

Conclusions. The character and dominant orientation of training influences for female middle-distance runners at the stage of advanced specialisation were determined by month of the preparation macrocycle. The data obtained indicate that the modulation of load parameters in terms of volume and orientation, as well as content and character, must correspond not only to the strategic objectives of athletes' preparation in the macrocycle but also be commensurate with the biorhythmological patterns of their body's functioning in the mesocycle. Such an organisation of the training process, based on the

constant consideration of the individual characteristics of each athlete, is the most justified at the stage of advanced specialisation, setting target benchmarks for the construction of preparation at the next stage of long-term improvement.

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System-structural approach to the analysis of game actions in team sports

UDC 796.012

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Abstract

Objective of the study is to substantiate the structure and composition of game actions in team sports on the basis of the system-structural approach.

Methods and structure of the study. The substantiation of the problem was carried out on the basis of scientific data obtained in 2020–2025 during research with young and qualified basketball and volleyball players (Smolensk, Voronezh, Samara, Obninsk). The research included biomechanical analysis of kinematic and dynamic characteristics under various competitive conditions, which made it possible to determine the main contours of the coordination structure of athletes' game actions in team sports. The obtained data made it possible to substantiate the main motor components determining the competitive behaviour of a player and to construct multi-year preparation on this basis.

Results of the study and discussion. In the theory and methodology of team sports, motor actions are examined from the perspective of the system-structural approach, which makes it possible to establish complex interrelationships of elements possessing properties inherent only to them. Such interrelationships determine the patterns of functioning of a specific model.

Keywords: *team sports, motor actions, game actions, system-structural approach, training activity, competitive behaviour.*

Introduction. The issues of studying, generalising and substantiating motor actions in game sports have always been and remain among the most relevant, as the theoretical understanding of this issue is quite difficult, which hinders the establishment of the structure and composition of elements ensuring the determination of the mechanism for their effective formation in the multi-year training and competitive process [2, 3, 5].

The interaction of structural elements is determined by external and internal factors of competitive activity, which condition the theoretical development and methodological substantiation of modern approaches and technologies that meet modern realities and trends in the development of game activity in team sports [1, 4, 6].

Thus, the scientific search aimed at studying the definitions, structure and composition of game actions, as well as the application of effective preparation methodologies, ensures the resolution of this rel-

evant and significant issue in the context of the general methodology of game activity in team sports.

Objective of the study is to substantiate the structure and composition of game actions in team sports on the basis of the system-structural approach.

Methods and structure of the study. The substantiation of the problem was carried out on the basis of scientific data obtained in 2020–2025 during research with young and qualified basketball and volleyball players (Smolensk, Voronezh, Samara, Obninsk). The research included biomechanical analysis of kinematic and dynamic characteristics under various competitive conditions, which made it possible to determine the main contours of the coordination structure of athletes' game actions in team sports. The obtained data made it possible to substantiate the main motor components determining the competitive behaviour of a player and to construct multi-year preparation on this basis.



Results of the study and discussion. In the theory and methodology of team sports, motor actions are examined from the perspective of the system-structural approach, which makes it possible to establish complex interrelationships of elements possessing properties inherent only to them. Such interrelationships determine the patterns of functioning of a specific model (Figure 1).

The study of models from the perspective of the system-structural approach makes it possible to establish external and internal features of game actions, which subsequently serve as those markers and basic points, the impact on which in training activity ensures the achievement of high individual and collective technical and tactical mastery.

The proposed system-structural approach and its application makes it possible to generalise the already available information and our own research results and to assert that, abstracting from the psychological features of game actions, it should be noted that they possess their own structure, which includes various external and internal component elements.

The external structure of game actions in team sports is determined by spatial, temporal and spatial-temporal kinematic characteristics, which form phases of movements resolving local motor tasks. The internal structure of game actions is represented by anatomical, functional, informational and intellectual characteristics that determine the dynamics of movement. At the same time, it should be noted that

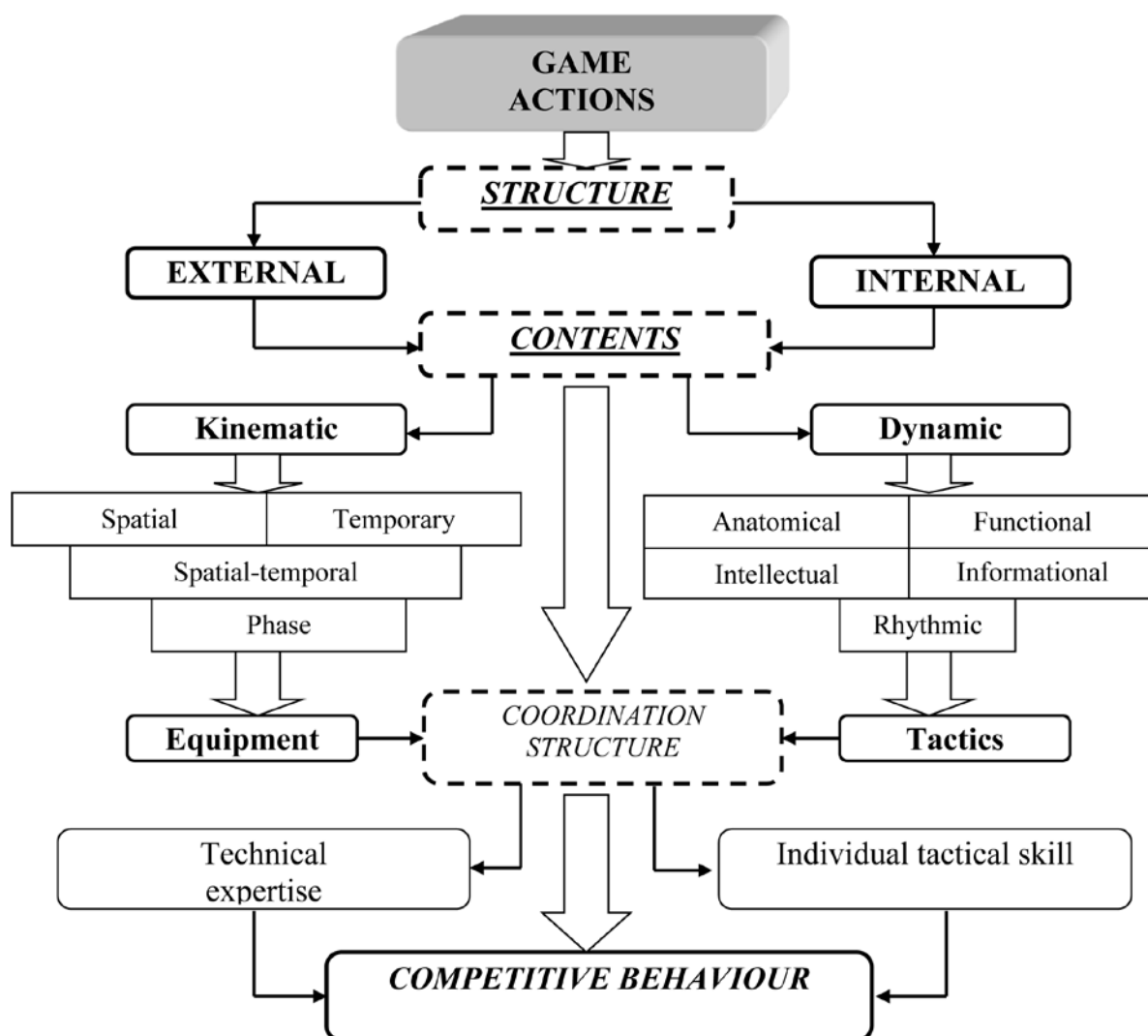


Figure 1. Model of the structure and composition of athletes' game actions in game sports based on the system-structural approach



all characteristics determining the dynamics of movements are reflected in the rhythm of the game, which undoubtedly determines the tactics of subjects in the process of competitive activity.

The combination of kinematic and dynamic characteristics, which, interacting with each other during the execution of technical techniques and tactical actions, form the coordination structure determining the competitive behaviour of the athlete through the application of a specific technical game technique in a game situation, which constitutes the individual tactics of each player.

The ability of coaches in the process of organising the multi-year training process of athletes in game sports to effectively influence the coordination structure of game actions makes it possible to substantially advance in resolving issues related to technical and tactical preparation.

The theory and practice of sports reserve preparation and highly qualified athletes in game sports indicates that the formation of rational and effective game actions should include not only the mechanical execution of training tasks, but also actively immerse the athlete in the meaningful part of the movements performed in a specific situation of confrontation with the opponent. Only the combination of external and internal parameters of movements in the structure of game actions makes it possible to identify key aspects of the coordination structure, which serves as the basis for constructing multi-year preparation.

Conclusions. Technical techniques representing the external structure of game actions are not capable of independently resolving competitive tasks. Ignoring the internal side of game actions does not allow the use of these techniques in various game situations with high productivity and effectiveness. Therefore,

when organising multi-year preparation of athletes in game sports, it is important to unite these two components into a unified concept, which is expressed by the coordination structure of all movements applied in training and competitive activity.

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Improving the mechanisms for developing the speed capabilities of young sprint swimmers

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Abstract

Objective of the study is to investigate the influence of alactic, glycolytic and aerobic energy production mechanisms on the performance of young swimmers in short-distance swimming.

Methods and structure of the study. In a test involving a stepwise increase in load, average and maximum power outputs were measured at a rotation speed of 70 rpm for arm-driven exercise and 60 rpm for leg-driven exercise. Correlation coefficients were calculated between swimming speed and anaerobic and aerobic capacity.

Results and conclusions. It has been established that the activating stimuli of speed-strength exercises, designed to develop maximum power in the arms and legs, lead to a deepening of the adaptive changes in swimmers' bodies.

Keywords: *sprint swimmers, energy systems, speed capacity.*

Introduction. Systematic monitoring of physical performance indicators makes it possible to make appropriate adjustments to the training programme with a view to achieving the best possible sporting results.

Energy supply for muscular activity in sport is based on three main sources of energy production. The anaerobic alactate method of energy production is characterised by the breakdown of creatine phosphate (CP) in the mitochondria. The anaerobic lactate energy supply system involves the catabolism of carbohydrates, primarily muscle glycogen. The aerobic metabolic process involves the breakdown of carbohydrates, free fatty acids and, to some extent, proteins [6].

Taken together, all three pathways ensure the resynthesis of ATP, the formation of adenosine 5'-triphosphate, and reach their peak in the presence of creatine phosphate. The biochemical processes described allow skeletal muscles to rapidly develop force under physical exertion [5].

The mechanisms of phosphagen energy supply for swimmers' performance have not been sufficiently studied. A statistically significant correlation has been

established between leg explosive strength and the performance of sprint swimmers, both during the start and whilst covering the distance [1].

A high level of anaerobic glycolytic energy supply determines the efficiency of stroke efforts over several tens of seconds [2].

Maximal oxygen uptake determines the performance of swimmers specialising in short-distance swimming events lasting approximately 60 seconds. In the 60-second test assessing anaerobic capacity, oxygen consumption during the final 30 seconds of exercise is 90.5–92% of O₂max[3].

There are various methods for measuring O₂max. The most common method involves a gradual increase in intensity, whilst continuous or interval training is used less frequently. Due to the specific nature of swimming, testing swimmers on ergometers is usually carried out in laboratory conditions. In flow tanks, such tests are performed in a water current, whilst in a swimming pool, 'tethered swimming' is used [4].

Objective of the study is to investigate the influence of alactic, glycolytic and aerobic energy produc-



tion mechanisms on the performance of young swimmers in short-distance swimming.

Methods and structure of the study. The performance of 32 sprint swimmers aged 14.5 ± 0.9 years was studied. Each participant performed five laboratory tests and two swimming tests: the vertical jump; a test of aerobic endurance of the arm and leg muscles with progressive load; a one-minute test of anaerobic endurance of the arm and leg muscles; a 50 m swim; a 100 m swim.

The O_{2max} tests for the arms were performed in a seated position on an 884-Ergomedic cycle ergometer. The O_{2max} aerobic capacity test for the legs was performed on an ER 900 Jaeger ergometer. The ergometer resistance was set for each subject at 7.5% of the maximum in the leg muscle tests and at 4.5% of the maximum in the arm muscle tests. The tests were preceded by a 5-minute warm-up.

The intensity of the O_{2max} test for arm work ranged from 60 to 90 W depending on the swimmer's age and endurance, and was increased by 12 or 18 W every three minutes.

Average and maximum power values were determined in an anaerobic endurance test involving the upper and lower limbs, measured in a test with a stepwise increase in load and a rotation speed of 70 rpm for arm work and 60 rpm for leg work. Gas exchange parameters were calculated using the 919ER MEDIKRO device as the average of maximum oxygen consumption (O_{2max}) over a 15-second period of exercise.

To determine lactate concentration using the Lactate Plus (Sport) analyser, a finger-prick blood sample

was taken three minutes after completing the anaerobic and swimming tests.

Maximum power and work load during a single high jump were recorded using the Opto Jump Next device. The shift in the centre of gravity during the high jump was assessed based on the duration of the jump.

Partial correlation coefficients were calculated to determine the relationship between swimming speed and anaerobic and aerobic capacity. All tests were conducted using the STATISTICA 12 software.

Results of the study and discussion. The key statistical characteristics of the energy indicators are presented in Table 1.

The average power generated by the arms and legs is strongly correlated with swimming speed over 50 and 100 metres, whilst maximum power correlates with these indicators to a lesser extent. Maximum power generated by the lower limbs and total work output in the vertical jump test had a significant influence on swimming speed over 50 and 100 metres. All of the above indicators of physical endurance correlated significantly with the arm movement coordination index in the 50 m swim. Furthermore, a significant average correlation was observed between O_{2max} in the upper and lower limb performance tests and swimming speed over 50 and 100 m.

Following anaerobic exercise involving arm work, the average blood lactate concentration was approximately 12.6 ± 1.73 mmol/l, and in the leg work test, it was 14.1 ± 1.46 mmol/l. At the 3-minute recovery mark following the 100 m swim test, blood lactate concentration was 12.2 ± 1.89 mmol/l and was statistically

Table 1. Swimmers' energy metrics

Parameter	P of arms, W	P_{max} of arms, W	P of legs, W
$x \pm SD$	$284,4 \pm 55,6$	$349,9 \pm 83,4$	$468,8 \pm 76,7$
Parameter	P_{max} of legs, W	O_{2max} of arms, l/min	O_{2max} of legs, l/min
$x \pm SD$	$655,3 \pm 95,1$	$3,14 \pm 0,54$	$3,82 \pm 0,53$

Note: O_{2max} – MOC (VO_{2max}); P – average power output; P_{max} – maximum power output.

Table 2. The relationship between energy metrics and swimming speed over 50 and 100 metres

Indicator	V50	V100
Average power output (arms)	0,523	0,575
Maximum power output (arms)	0,465	0,445
Average power output (legs)	0,674	0,678
Maximum power output (legs)	0,859	0,734
MOC (arms)	0,365	0,465
MOC (legs)	0,543	0,528



significantly higher than after the 50 m swim test – 7.8 ± 1.96 mmol/l.

In sprint swimming, the swimmer's forward speed depends primarily on the efficiency of anaerobic glycolytic mechanisms for supplying energy to muscle work, which is confirmed by high correlation coefficients between indicators of maximum power obtained in one-minute anaerobic tests involving arm and leg movements and swimming speeds over 50 and 100 m.

A significant contribution to the anaerobic energy supply mechanisms under these conditions is made by the high concentration of lactate in the blood following training. In all the athletes examined, this was highest after the 100 m front crawl. Given the metabolic profile, it can be concluded that young sprint swimmers demonstrate high efficiency in the utilisation of anaerobic energy. This is confirmed by the correlation between swimming test results and $O_2\max$ values during arm and leg work, ranging from $r = 0.37$ to $r = 0.53$ ($p < 0.05$). Furthermore, results in the 50 m and 100 m swimming events show a high correlation with most indicators of anaerobic performance – the work output during a counter-movement vertical jump, and the maximum power output of the arms and legs ($r = 0.96$).

Conclusions. The findings of the study confirmed that alactic, glycolytic and aerobic energy production mechanisms have a significant impact on the performance of young swimmers in short-distance swimming. The stimulating effects of speed-strength exercises, aimed at developing maximum power in the arms and legs, ensure a deepening of adaptive changes in the swimmers' bodies. The improvement of anaerobic energy supply mechanisms in sprint

swimming is facilitated by high blood lactate concentrations following training in the water.

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Improving adaptability to competitive strain through comprehensive training for badminton players

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Abstract

Objective of the study is to investigate the potential of integrated training methods in improving badminton players' adaptation to competitive stress.

Methods and structure of the study. At the end of the main part of the session, the badminton players performed a set of integrated training exercises for 20-25 minutes. The assessment of the effectiveness of integrated training was based on indicators of physical, technical, functional and psychological fitness.

Results and conclusions. The integrated stimuli of physical and technical exercises, which reflect the specific nature of competitive loads to the greatest extent, ensure the stability of badminton players' technical actions. The use of integrated training methods during the competitive phase of preparation ensures high stability of the athletes' physiological functions.

Keywords: *badminton techniques, integrated training, competitive phase, adaptive abilities.*

Introduction. Competitive badminton is characterised by a high match frequency, which requires athletes not only to be in excellent physical and technical condition, but also to be able to recover quickly between matches [1]. The literature emphasises that, under repeated match loads, athletes experience a significant reduction in strength, power-speed qualities and shot accuracy, as well as a deterioration in respiratory function [3, 4].

During the competitive period, the focus is predominantly on maintaining the level of athletes' physical development, which leads to the isolation of individual aspects of integrated training and is the cause of a reduction in badminton players' adaptive abilities [2]. A promising approach to addressing this issue is the development of integrated training methods based on combining physical, technical, functional and psychological components in a regime that is as close as possible to competitive activity [5]. However, there has been insufficient experimental research into

maintaining the physical and technical performance of high-level badminton players in the context of repeated matches.

Objective of the study is to investigate the potential of integrated training methods in improving badminton players' adaptation to competitive stress.

Methods and structure of the study. The study involved 30 highly skilled badminton players aged 17.7 ± 0.5 years, who formed a control group (CG, $n=12$) and an experimental group (EG, $n=18$), both of which were homogeneous in terms of fitness level. The study lasted 8 weeks, which corresponds to the period during which stable adaptive changes develop in highly skilled athletes.

The control group trained according to the standard programme for the competitive period: technical and tactical sessions (40%), physical training (30%), and match practice (30%).

Three times a week, at the end of the main part of the session, the experimental group performed a



20-25-minute complex of integrated training methods, including:

1. Exercises for accuracy of attacking shots and serves under conditions of fatigue – a series of 10 shots with the task of hitting the relevant areas of the court after a 10-second acceleration.

2. Competitive game-based tasks under time pressure and external distractions (varying serve speed, working at a heart rate of 170-180 bpm).

3. Psychological tasks (completing a 3-minute proofreading test after intense play, attention-switching exercises).

4. Participation in two consecutive matches with a 15-minute active recovery period (walking, breathing exercises, the athlete's subjective assessment of fatigue levels).

All tests were conducted under standard conditions: prior to the start of the competition series (baseline) and immediately after the conclusion of the second match (within 5-7 minutes). Athletes from both groups participated in the same competition rounds, ensuring identical external conditions.

To assess the effectiveness of integrated training, indicators of physical, technical, functional and psychological fitness were determined.

The physical fitness tests used included: a verti-

cal jump to assess explosive strength of the lower limb muscles (Abalakov test); handgrip strength; the Y-balance test for dynamic postural control and body stability during movement.

Technical fitness was assessed using exercises to measure the accuracy of the attacking stroke via expert evaluation of the shuttlecock landing in a designated zone (1×1 m square) over 10 attempts (0–5 points). Serving accuracy was assessed by the total number of short and long serves landing in the target zones (0.5×0.5 m) during 10 serves.

Functional status was determined based on heart rate at the 30th minute of active recovery; the percentage of the initial resting state was calculated; lactate concentration in capillary blood at the 3rd minute after the second match (mmol/l).

Psychological readiness (resilience) was determined by the results of a proofreading test (Toulouse-Pierron test, 3 minutes) based on the total number of errors made.

Statistical analysis of the results was performed by calculating the arithmetic mean (M), standard deviation (σ), and the significance of differences using Student's t-test for paired and independent samples. Differences were considered statistically significant at $p < 0.05$.

Table. Performance trends among badminton players following participation in two consecutive matches

Indicator	Group	Before	After	p
Vertical jump, cm	CG	44,2±3,1	38,5±3,8	< 0,05
	EG	44,5±3,0	41,8±3,2	> 0,05
Dynamic strength test, kg	CG	42,3±3,5	37,5±4,2	< 0,05
	EG	42,8±3,3	41,2±3,8	> 0,05
Y-balance, %	CG	89,7±4,1	78,2±5,3	< 0,05
	EG	90,2±3,9	84,6±4,5	> 0,05
Accuracy of attacking shot, points	CG	4,3±0,4	3,1±0,5	< 0,05
	EG	4,4±0,3	4,0±0,4	< 0,05
Accuracy of serve, number of times	CG	8,2±0,8	6,1±1,0	< 0,05
	EG	8,3±0,7	7,6±0,9	< 0,05
Heart rate after 30 minutes, % of resting heart rate	CG	-	78,4±6,2	-
	EG	-	94,2±4,1	-
Lactate after match 2, mmol/l	CG	-	8,7±1,2	-
	EG	-	6,9±1,0	-
Proofreading test, errors	CG	4,1±1,0	7,8±1,8	< 0,05
	EG	4,2±0,9	5,4±1,2	< 0,05



Results of the study and discussion. Prior to the start of the study, there were no statistically significant differences between the groups across all measured parameters, confirming that the sample was correctly selected. Following the second match, a statistically significant reduction in all parameters was observed in the control group, whereas the deterioration was considerably less pronounced in the experimental group.

In the experimental group, the reduction in jump height was only 6.3% compared with 13.3% in the control group, whilst a direct intergroup comparison following the exercise revealed a statistically significant advantage for the experimental group, with a difference in results of 3.3 cm; this is consistent with the hypothesis that an integrative approach is beneficial for maintaining levels of explosive strength. The statistically significant changes in dynamometry and Y-balance in the EG indicate greater stability of the neuromuscular system and postural control, which are critically important qualities for a badminton player.

The recorded improvement in functional indicators reflects an increase in the efficiency of recovery processes among badminton players in the experimental group, whose heart rates return to baseline levels, demonstrating the benefits of the differentiated use of recovery methods during the competitive phase of training.

Performing a 3-minute proofreading test after an intense match, along with attention-switching exercises, explains the shift in psychological state characteristic of the peak readiness phase. This can be attributed to training in concentration and attention-switching exercises following physical exertion.

Integrated training, including exercises on the accuracy of attacking shots and serves under conditions of fatigue, develops the stability of the motor skills involved in attacking shots and serves under competitive conditions.

Conclusions. The results of the study demonstrate the effectiveness of integrated training in managing the adaptation processes of highly skilled badminton players to competitive stress. Integrated stimuli from physical and technical exercises, functional training and psychological tasks, which reflect the specific nature of competitive loads as closely as possible, ensure the stability of badminton players' technical actions. The use of integrated training methods during the competitive phase of preparation ensures a high level of stability in athletes' physiological functions.

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Training system in team sports under modern conditions of sports reserve preparation

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Abstract

Objective of the study is to generalise the current directions of the existing training system in team sports taking into account modern conditions of sports reserve preparation.

Methods and structure of the study. To determine and substantiate the current directions for improving supplementary educational programmes in team sports under modern conditions of domestic sport development and sports reserve preparation, theoretical methods-actions (operations), empirical methods, logical methods, as well as systems methods were used.

Results of the study and discussion. For the optimisation of sports reserve preparation in the country, Order No. 999 of 30.10.2015 was approved by the Ministry of Sport of the Russian Federation, and subsequently amendments No. 325 of 17.05.2023 were introduced, which regulate the requirements for ensuring sports reserve preparation taking into account domestic Championships and Cups of the country in volleyball, basketball and football. The necessity of continuity in the organisation of the training process in sports schools, academies and clubs through the optimisation of the content and practical implementation of supplementary educational programmes of sports training at various stages of training and the fulfilment of the requirements of Federal State Educational Standards of sports training by sport discipline is noted.

Keywords: *sports reserve preparation, team sports, professional teams, federal standard of sports training, supplementary educational programmes of sports training.*

Introduction. International restrictions under modern conditions of sport development have both a negative and a positive side to the issue under consideration. The negative aspect is that Russian highly qualified players almost always lose in terms of individual sporting mastery to leading foreign athletes [2, 3]. Due to the difficulty of attracting quality foreign players and leading coaches to basketball, volleyball and football leagues in Russia, caused by international sanctions and bans by foreign regional federations, a decline in the rate of sporting mastery progress among leading national team players is observed, who under conditions of high competition could additionally reveal their individual capabilities and hidden potential [4, 6]. The other – positive – side of the existing problem indicates that the mass exodus of foreign players, many of whom in terms of

the main sporting components (physical preparedness, technical-tactical actions, psychological stability) were inferior to domestic players, especially in basketball and football, provided the opportunity to give more playing time to promising and talented young domestic players [1, 5].

The changes taking place, caused by the international agenda, indicate that a favourable period of time is approaching for the improvement of the entire system of domestic sport functioning, which should consist of the revision, modification and specification of the entire structure and content of sports reserve preparation for achieving high sporting mastery.

Objective of the study is to generalise the current directions of the existing training system in team sports taking into account modern conditions of sports reserve preparation.



Methods and structure of the study. To determine and substantiate the current directions for improving supplementary educational programmes in team sports under modern conditions of domestic sport development and sports reserve preparation, theoretical methods-actions (operations), empirical methods, logical methods, as well as systems methods were used.

Results of the study and discussion. For the optimisation of sports reserve preparation in the country, Order No. 999 of 30.10.2015 was approved by the Ministry of Sport of the Russian Federation, and subsequently amendments No. 325 of 17.05.2023 were introduced, which regulate the requirements for ensuring sports reserve preparation taking into account domestic Championships and Cups of the country in volleyball, basketball and football. The necessity of continuity in the organisation of the training process in sports schools, academies and clubs through the optimisation of the content and practical implementation of supplementary educational programmes of sports training at various stages of training and the fulfilment of the requirements of Federal State Educational Standards of sports training by sport discipline is noted.

Supplementary educational programmes in team sports are designed for the effective organisation of educational activities in sports schools, sports academies and clubs, taking into account the totality of minimum requirements determined by the federal standard of sports training. The objective of implementing supplementary educational programmes in team sports is the achievement of high sporting results on the basis of observing sporting and pedagogical principles in the training process under conditions of a multi-year, year-round and stage-by-stage process of sports reserve preparation under modern conditions of domestic sport development.

Analysis of the developed and approved exemplary supplementary programmes of sports training in team sports showed that they are insufficiently adapted to the conditions of international restrictions and the requirements of professional sports teams. It was established that sports schools carry out their activities without accounting for the interests of sports teams representing various regions of the country, which does not allow ensuring a constant influx of their own graduates into professional clubs. The majority of sports schools prepare sports teams rather than universal players. This fact is confirmed

by the requirement that already at the age of 10–12 children must demonstrate high sporting results in competitions at regional and all-Russian levels. Such requirements at the initial preparation stage fundamentally contradict the system-structural approach, which is key at this stage and provides for the formation of rational and effective motor actions in each player that determine the level of individual sporting mastery in professional sport. Athletes are simply drilled for sporting results.

The practice of preparing athletes in team sports indicates that in addition to high physical and technical-tactical abilities, the athlete must have a broad spectrum of knowledge about the possibilities of realising their technical potential in various tactical situations of competitive matches. In this connection, when implementing supplementary educational programmes, specialists must devote sufficiently close attention to theoretical preparation, which should ensure the formation of knowledge about the motor actions of athletes. The improvement of thought processes related to the intellectual sphere of the athlete and the development of mental processes (perception, attention, memory) enabling correct decision-making in various game situations of competitions must be carried out after rational technique and tactics have been formed – the stage of sports specialisation and mastery improvement. However, as analysis of the content of supplementary educational programmes of sports training in team sports shows, insignificant time is allocated to these components of sports training; the volume of time is mainly redistributed to physical and game preparation, thereby implementing only the principle of drilling players for sporting results through a large number of competitions.

Conclusions. Regulation of the sports reserve preparation system indicates the expediency of revising the entire training system for athletes in team sports, which should be guided by the following provisions:

- universalisation of individual mastery of a specific athlete at the stages of initial preparation and sports specialisation;
- exclusion of approaches aimed at preparing a sports team in sports schools, academies and clubs;
- it is urgently necessary to move away from drilling players for sporting results at the stages of initial preparation and sports specialisation;



- increase the volume of time for studying game technique and tactics;

- at the stage of sports specialisation, improve physical preparedness indicators, and at the stage of mastery improvement, theoretical and intellectual preparedness;

- maximally activate the psychological preparation and recovery measures for athletes.

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Planning physical preparation of student volleyball players for club competitions using the BIODEX platform

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Abstract

Objective of the study is to develop a methodology for planning physical preparation of student volleyball players for club competitions using the BIODEX platform.

Methods and structure of the study. The study was conducted at the MSU sports complex from September to December 2023. It involved 28 student volleyball players aged 18-23, with qualifications of no lower than first rank and 5-9 years of experience. Participants were randomly assigned to control and experimental groups of 14 persons each, comparable in anthropometric indicators. The control group followed the standard programme including three court training sessions and two gym sessions per week. In the experimental group, one gym session was replaced with training on the BIODEX SYSTEM PRO-4 platform, conducted twice a week for 30 minutes.

Results of the study and discussion. Application of the BIODEX platform proved more effective than the standard preparation programme. In the experimental group, the jump increase was 6.2 cm versus 1.8 cm in the control group, height decrease in a series of 15 jumps was 6% versus 14%, and post-landing stabilisation time decreased from 1.6 to 0.8 s versus 1.4 s in the control group. The endurance indicator improved 2.0 times versus 1.14 times, ankle injuries numbered 1 case versus 7, knee injuries were absent whereas there were 2 in the control group. In five control matches, a 22% increase in successful blocks was also noted.

Keywords: volleyball, students, physical preparation, planning, club competitions, BIODEX, unstable support, proprioception, jump preparation, preparatory period.

Introduction. Modern volleyball is characterised by increasing speed-strength demands, growing intensity of game episodes and increasing significance of athletes' coordination readiness. In student sport, this problem is exacerbated by the limited number of training sessions, the need to combine technical, tactical and physical preparation, as well as an insufficiently stable level of mastery of motor actions among some participants. According to I.M. Simonova, students engaged in volleyball frequently exhibit errors related to coordination, difficulty transitioning from one technical action to another and insufficient ability to quickly model motor activity under game conditions [5].

Scientific literature has shown that increasing the effectiveness of preparation is possible through the purposeful use of special means. Regular volleyball practice contributes to the improvement of strength, speed and coordination. Integration of fitness means into the training process positively influences jumping ability, speed and competitive performance [2]. Application of technical means enables stricter dosing of load and increased individualisation of preparation [3]. The use of real-time information and biomechanical monitoring contributes to more accurate correction of motor actions [1, 4]. In this regard, the application of the BIODEX platform as a means of planning special physical preparation of student vol-



leyball players in the pre-competitive period is of interest.

Objective of the study is to develop a methodology for planning physical preparation of student volleyball players for club competitions using the BIODEX platform.

Methods and structure of the study. The study was conducted at the MSU sports complex from September to December 2023. It involved 28 student volleyball players aged 18-23, with qualifications of no lower than first rank and 5-9 years of experience. Participants were randomly assigned to control and experimental groups of 14 persons each, comparable in anthropometric indicators. The control group followed the standard programme including three court training sessions and two gym sessions per week. In the experimental group, one gym session was replaced with training on the BIODEX SYSTEM PRO-4 platform, conducted twice a week for 30 minutes.

The methodology included four exercises aimed at developing balance, jump stability, dynamic strength and reactive ability: single-leg balance hold, vertical jump with landing on unstable support, lunges on a moving platform and jumps onto the platform with stabilisation time control. The load was increased every three weeks through increasing platform deviation amplitude and reducing stabilisation time. Control testing was conducted three times: at the beginning of September, after six weeks and at the end of December. Jump height from a standing position, stability in a series of 15 jumps, post-landing stabilisation time and lower extremity injury cases accompanied by missed training sessions were assessed.

Results of the study and discussion. Application of the BIODEX platform proved more effective than the standard preparation programme. In the experimental group, the jump increase was 6.2 cm versus 1.8 cm in the control group, height decrease in a series of 15 jumps was 6% versus 14%, and post-landing stabilisation time decreased from 1.6 to 0.8 s versus 1.4 s in the control group. The endurance indicator improved 2.0 times versus 1.14 times, ankle injuries numbered 1 case versus 7, knee injuries were absent whereas there were 2 in the control group. In five control matches, a 22% increase in successful blocks was also noted.

Conclusions. The developed methodology for planning physical preparation of student volleyball

players using the BIODEX platform can be considered an effective option for organising the pre-competitive stage. Its content includes exercises for balance, jump stability, dynamic strength and reactive ability, and the load is structured on the principle of gradual progression. The optimal approach appears to be the inclusion of two sessions per week lasting 30 minutes over 12-16 weeks of the preparatory period. The methodology can be recommended for use in universities with modern material and technical facilities.

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Patterns of young hockey players' mastering of skills to perform special complex coordination exercises

UDC 796.966

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Abstract

Objective of the study is to identify the pattern of young hockey players' mastering of skills in performing special complex coordination motor acts – using the example of mastering the exercise 'Slalom with a puck.'

Methods and structure of the study. The research was conducted with the participation of hockey players from a sports school of different age groups. At the end of the preparatory and competitive periods, testing was carried out using the exercises 'Slalom without a puck' and 'Slalom with a puck.' For each individual age group of hockey players, the group-average indicators of the difference in results of the players' performance of the specified exercises were calculated, characterising the degrees of mastery of the complex coordination exercise 'Slalom with a puck.' A comparison of these indicators was carried out, correlated with data on the number of training sessions of hockey teams in which the exercise 'Slalom with a puck' was used.

Results and conclusions. A pattern was identified in young hockey players' mastering of skills in performing special complex coordination motor acts, according to which the degree of mastery of these motor acts by hockey players depends on the number of training sessions in which they are performed by the players.

Keywords: *testing of hockey players on ice, special complex coordination exercises, difference in results of performing exercises "Slalom without a puck" and "Slalom with a puck".*

Introduction. The game of hockey is characterised by a large number of both relatively simple and more complex motor acts that hockey players need to master for successful participation in competitions [3, 4, 6, 7, 9, 9, 11]. Mastering the skills of performing complex coordination motor acts is a lengthy process [1, 2, 3, 4]. The exercises 'Slalom without a puck' and its more complex variant 'Slalom with a puck', performed by hockey players on ice (see Figure) – belong to special complex coordination exercises and to elements of the game of hockey that ensure the game actions of hockey players.

By the difference in the results of high-speed performance of these exercises by hockey players, one can judge the degree of their mastery of the more complex variant of the exercise "slalom with a puck". On the basis of generally accepted theoretic-

cal provisions in sports pedagogy [1, 3, 4, 5, 8] and the results of practical work with athletes [2, 5], the assumption was made that the degree of mastery by hockey players of the complex coordination exercise 'slalom with a puck' depends on the number of training sessions in which the players perform this exercise.

Objective of the study is to identify the pattern of young hockey players' mastering of skills in performing special complex coordination motor acts – using the example of mastering the exercise 'Slalom with a puck.'

Methods and structure of the study. The research involved hockey players of teams from one of Moscow's sports schools of the age groups 10-11 years, 11-12 years, 12-13 years, 13-14 years, 14-15 years and 15-16 years. The approximate number of training sessions of hockey teams in which the

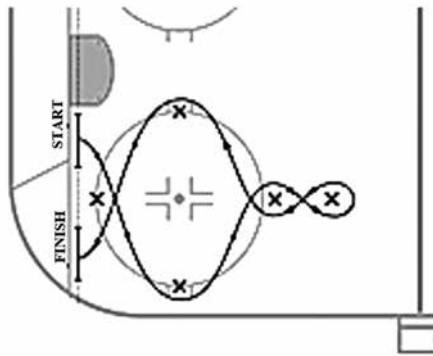


Figure. Diagram of performing the exercises 'Slalom without a puck' and 'Slalom with a puck'

exercise "slalom with a puck" was used was estimated on the basis of coaches' reports on the training work completed by athletes. Monitoring of the correspondence of data provided by team coaches to the actual content of the training process was carried out using the method of pedagogical observation. In tests conducted at the end of the preparatory (summer) and competitive (spring) periods, the results of hockey players' performance of the exercises 'slalom without a puck' and 'slalom with a puck' were recorded using an electronic stopwatch. For each age group of hockey players, indicators of the difference in results of their performance of the indicated exercises were calculated. A comparison of group-average indicators of the difference in results of performing the indicated exercises by team hockey players in summer and spring tests was conducted. Methods of mathematical statistics and data on the number of training sessions of hockey teams in which the exercise 'slalom with a puck' was used were employed for analysis of the obtained indicators.

Results of the study and discussion. Table 1 presents data on the approximate number of train-

ing sessions in the preparatory (8 weeks) and competitive (24 weeks) periods in which hockey players of different age groups used the exercise 'Slalom with a puck.'

The data presented in Table 1 indicate: the exercise 'slalom with a puck' in the preparatory period was regularly used only in the training of the team of the age group 12–13 years; the same exercise in the same period was episodically used in the training of teams of the age groups 10–11 years, 11–12 years and 15–16 years; the same exercise was not used in the preparatory period in the preparation of teams of the age groups 13–14 years and 14–15 years; the exercise 'slalom with a puck' in the competitive period was regularly used in the training of teams of the age groups 11–12 years and 12–13 years; the same exercise in the same period was episodically used in the training of teams of the age groups 10–11 years and 13–14 years; the same exercise was not used in the same period in the preparation of teams of the age groups 14–15 years and 15–16 years.

Table 2 presents the group-average indicators of the difference in results of performing the test exercises "slalom without a puck" and "slalom with a puck" by hockey players of teams of different age groups, demonstrated by players in summer and spring tests.

The differences in group-average results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 10–11 years in summer and spring tests are not significant ($p \geq 0.6$). Hockey players of the indicated age group did not improve this indicator in the competitive period, which is explained by the episodic nature of performing the exercise "slalom with a puck" in training sessions of the indicated period. This also explains the absence of correlation

Table 1. Approximate number of training sessions in the preparatory (8 weeks) and competitive (24 weeks) periods in which hockey players of different age groups used the exercise 'Slalom with a puck'

Age group	Preparatory period	Competitive period
	The number of training sessions in which the ice hockey players used the 'Slalom with a puck' exercise	
10–11 years	8	24
11–12 years	8	72
12–13 years	24	72
13–14 years	0	24
14–15 years	0	0
15–16 years	8	0



Table 2. Group-average indicators of the difference in results of performing the test exercises "slalom without a puck" and "slalom with a puck" by hockey players of teams of different age groups, demonstrated by players in summer and spring tests

Age group	Testing	Difference in results of complex coordination exercises
10–11 years	Summer	0.65±0.36 s
	Spring	0.61±0.39 s
11–12 years	Summer	0.55±0.45 s
	Spring	0.32±0.24 s
12–13 years	Summer	0.36±0.27 s
	Spring	0.37±0.24 s
13–14 years	Summer	0.61±0.38 s
	Spring	0.34±0.26 s
14–15 years	Summer	0.56±0.36 s
	Spring	0.58±0.32 s
15–16 years	Summer	0.36±0.29 s
	Spring	0.59±0.36 s

($r=0.15$) between the indicators under consideration.

The differences in group-average indicators of the difference in results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 11–12 years in summer and spring tests are significant ($p \leq 0.05$). Hockey players of the indicated age group substantially improved this indicator in the competitive period, which is explained by the regularity of performing the exercise 'slalom with a puck' in training sessions of the indicated period. The absence of correlation ($r=0.09$) between the indicators under consideration is explained by differences in the indicators of the number of uses of the exercise 'slalom with a puck' by hockey players of this age group in the preparatory and competitive periods.

The differences in group-average indicators of the difference in results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 12–13 years in summer and spring tests are not significant ($p \geq 0.9$). The non-significance of differences in the indicated indicators is explained by the fact that players of this age group demonstrated a good indicator of the difference in results of performing the above-mentioned test exercises already in the summer testing. The team players managed to maintain a high level of training in performing the exercise 'slalom with a puck' throughout the competitive period, which is

explained by the regularity of performing the indicated exercise in this period. The moderate degree of correlation ($r=0.48$) between the indicators under consideration is explained by the regularity of performing the above-mentioned exercises by hockey players in training sessions throughout the entire annual preparation cycle.

The differences in group-average indicators of the difference in results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 13–14 years in summer and spring tests are significant ($p \leq 0.05$). Hockey players of the indicated age group improved this indicator in the competitive period. However, it should be noted that the summer indicator of the difference in results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 13–14 years turned out to be worse than the same indicator demonstrated by hockey players of the age group 12–13 years. This is due to the fact that the exercise 'slalom with a puck' was not used by hockey players of the age group 13–14 years in training sessions of the preparatory period. This also explains the absence of correlation ($r=0.04$) between the indicators under consideration.

The differences in group-average indicators of the difference in results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 14–15 years in summer and spring tests are not significant



($p \geq 0.8$). The absence of correlations ($r=0.03$) between the indicators under consideration is due to the fact that the exercise 'slalom with a puck' was not used in the preparation of hockey players in either the preparatory or the competitive periods.

The differences in group-average indicators of the difference in results of performing the test exercises 'slalom without a puck' and 'slalom with a puck' by hockey players of the age group 15–16 years in summer and spring tests are significant ($p \leq 0.05$). The group-average indicator of the difference in results of performing the above-mentioned exercises by hockey players of this age group, recorded in the spring testing, turned out to be worse than the analogous indicator recorded in the summer testing. This is due to the fact that the exercise 'slalom with a puck' was not used by hockey players of this age group in the training process of the competitive period. This also accounts for the absence of correlations ($r=0.004$) between the indicators under consideration.

Conclusions. The episodic use of special complex coordination motor acts in training sessions of young hockey players does not ensure effective mastery of the skill of their performance by the players. The degree of mastery of special complex coordination motor acts by young hockey players depends on the number of training sessions in which the players perform these exercises. The mastered skill of performing a special complex coordination motor act by young hockey players is not retained without its periodic use in the subsequent period of sports training. In connection with the above: the process of mastering special complex coordination motor acts by young hockey players must be carried out throughout the entire annual cycle of sports training.

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Morphofunctional model characteristics of ice hockey players across different playing positions

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Abstract

Objective of the study is to develop and experimentally validate a methodology for improving the technical and tactical skills of the libero in defense during the athletic development phase.

Methods and structure of the study. The research was conducted at the P.F. Lesgaft National State University of Physical Culture, Sport, and Health in St. Petersburg. The sample consisted of 46 male volleyball players aged 18 to 25, with qualification levels ranging from 1st class to Master of Sports. Two equal groups were formed – a control group and an experimental group, each consisting of 23 participants. The methodology involved a strict distribution of training load across priority training areas: development of anticipatory abilities (15%), specialized coordination training (20%), and situational simulation of game scenarios (30%). The combination of these training blocks ensured the structured development of skills for applying defensive actions in competitive settings.

Results and conclusions. The experiment showed that the level of tactical awareness increased by 18.2%, the effectiveness of receiving an attacking shot increased by 14.7%, while the success rate of receiving a serve increased by 9.3%. Anticipation of the spatiotemporal parameters of the ball's movement underwent the most pronounced transformation, exceeding the control group's indicators by 2.8 times and showing a 22.3% increase. The identified patterns confirm the fundamental role of perceptual-cognitive indicators in the initial stages, the accelerated growth of which lays the foundation for improving a volleyball player's technical and tactical actions.

Keywords: volleyball, libero, technical and tactical actions, defensive actions, stage of athletic development, anticipation.

Introduction. Modern volleyball is characterized by an increase in the pace of competition, which has led to the growing importance of the libero position – introduced by the International Volleyball Federation (FIVB) in 1998 – as a central element of the defensive line [7]. An analysis of competitive performance between team leaders and players in international volleyball tournaments reveals a significant gap in reception effectiveness [2]. This fact highlights the potential for improving performance during the athletic development phase by optimizing the technical and tactical actions of the libero position.

Today, the scientific and methodological foundation for training liberos during the sports improvement phase has been developed in a fragmented manner, downplaying the role of cognitive processes – anticipation and tactical thinking.

Objective of the study is to develop and experimentally validate a methodology for improving the technical and tactical skills of the libero in defense during the athletic development phase.

Methods and structure of the study. The methodology of this study was based on the principles of a randomized controlled trial evaluating a pedagogical intervention through the implementation of a proprietary training method. The experimental intervention lasted 36 weeks, from September 2024 to May 2025. Forty-six male volleyball players participated in the study. The age range of the sample was 18-25 years (experience: 8.7 ± 1.9 years). The qualification levels of the student-athletes were as follows: 1st category – 39.1%, Candidate Master of Sports – 43.5%, Master of Sports – 17.4%. Inclusion criteria for the study sample were the libero position, absence of injuries,



regular training, and consent to participate in the educational experiment. Exclusion criteria were chronic diseases hindering training activities and missing more than 15% of the total number of scheduled training sessions.

Participants were assigned to the experimental and control groups using stratified randomization (group homogeneity assessed by the Mann-Whitney U-test ($p > 0.05$)).

The primary research method was structured observation. Its objectivity was confirmed by a high Cohen's Kappa coefficient for inter-rater reliability (0.83). Assessment of the students' fitness level included testing to determine the effectiveness of receiving/serving, anticipation of the direction of the serve, tactical competence (expert assessment), as well as movement time and reaction time. Monitoring included these tests and video analysis (Kinovea software) [5]. An important feature of the diagnostic complex was the inclusion of volleyball players' subjective assessments as an integral part of monitoring their readiness to perform defensive actions [8]. Statistical analysis was performed in IBM SPSS Statistics 26 using the Shapiro-Wilk, Mann-Whitney, Student's t-test, and Wilcoxon's t-test ($p < 0.05$), and Cohen's d effect size. The experimental group (6 sessions/week, 90 min) followed the author's methodology, while the control group used the traditional approach.

The author's methodology combines five priority components:

1. Development of anticipatory abilities (15%): exercises to recognize the kinematic characteristics of attacking actions and performing exercises under limited visibility [6].

2. Situational modeling based on the analysis of Super League matches (30% of time): reenacting 12 typical situations with dynamic complexity (speed, number of attackers, power of the shot, block).

3. Weekly video analysis (10% of time) with a review of the team's own mistakes and examples of play by top-level players.

4. Specialized coordination training (20% of time): exercises that develop reaction speed, spatial orientation, kinesthetic differentiation, and adaptability of movements [3].

5. Technical and tactical training (25% of time): improving ball-handling technique with an emphasis on accuracy and refining tactical interaction patterns on the playing field [4].

The entire training process in the experimental group was structured according to the principle of progression, with weekly substantive analysis based on monitoring data.

Results of the study and discussion. The baseline homogeneity of the groups was confirmed by the absence of statistically significant differences at the pretest stage ($p > 0.05$, Mann-Whitney U test). Despite the overall positive trend at the end of the 36-week cycle, the experimental group showed a more pronounced increase in the indicators.

Table 1. Changes in technical and tactical fitness indicators among volleyball players in the control and experimental groups ($M \pm SD$)

Indicator	CG/EG	Before the experiment	After the experiment	Increase (%)	Intra-group p-value	Cohen's d
Effectiveness of blocking an attacking shot (%)	CG	41,8 $\pm$ 5,2	46,3 $\pm$ 5,0	+10,8	<0,05	0,52
	EG	42,1 $\pm$ 5,4	48,3 $\pm$ 4,6	+14,7	<0,01	0,89
Effectiveness of receiving a serve (%)	CG	54,6 $\pm$ 4,8	57,4 $\pm$ 4,5	+5,1	<0,05	0,41
	EG	54,2 $\pm$ 5,1	59,3 $\pm$ 4,2	+9,3	<0,01	0,78
Anticipation of shot direction (% correct answers)	CG	48,3 $\pm$ 6,7	52,1 $\pm$ 6,4	+7,9	<0,05	0,38
	EG	47,9 $\pm$ 7,0	58,6 $\pm$ 5,8	+22,3	<0,01	1,12
Tactical awareness (points, max. 5.0)	CG	3,21 $\pm$ 0,42	3,47 $\pm$ 0,39	+8,1	<0,05	0,44
	EG	3,18 $\pm$ 0,45	3,76 $\pm$ 0,35	+18,2	<0,01	0,98
Speed of movement in the defensive stance, 'herringbone' (s)	CG	8,64 $\pm$ 0,38	8,47 $\pm$ 0,35	-2,0	>0,05	0,31
	EG	8,61 $\pm$ 0,41	8,18 $\pm$ 0,33	-5,0	<0,01	0,82
Motor reaction time for shot selection (ms)	CG	312 $\pm$ 28	298 $\pm$ 26	-4,5	<0,05	0,36
	EG	315 $\pm$ 30	279 $\pm$ 23	-11,4	<0,01	0,95



The results of the study show a positive trend in defensive performance metrics in both groups; however, the experimental group (EG) demonstrated the most significant improvement in the technique of blocking an attacking strike. In the experimental group (EG), effectiveness increased by 14.7% (from an initial 42.1% to a final 48.3%; $d=0.89$, large effect), while in the control group (CG), the increase was limited to 10.8% (from 41.8% to 46.3%; $d=0.52$, moderate effect). The improvement in the EG is driven by the synergy of anticipation and technique, allowing players to optimize their movement timing and ensure the most accurate ball placement [1].

At the same time, quantitative indicators of serve reception effectiveness in the experimental group showed a less pronounced increase (9.3%) compared to the reception of a forehand shot due to a higher baseline level (54.2%) and the lower difficulty of executing this element. Nevertheless, the between-group differences remain statistically significant ($p<0.05$), and the effect size in the EG ($d=0.78$) exceeds the result in the CG ($d=0.41$).

The most significant contrast was observed in the indicator of shot direction anticipation: the increase in the EG was 22.3% (from 47.9% to 58.6%) with an effect size of $d=1.12$, which is classified as a large effect, while in the CG this indicator increased by only 7.9% (from 48.3% to 52.1%).

The high results in the EG are due to the integration into the training process of targeted work on recognizing the kinematic signs of attacking actions and the use of video analysis technologies. In the execution of the attacking strike, the EG showed an increase of 14.7% ($d=0.89$) compared to 10.8% in the CG, which is explained by the combination of improved anticipation and movement technique. In the serve reception, the improvement in the EG was 9.3% ($d=0.78$), which also exceeds the results of the CG ($d=0.41$); the less pronounced progress is associated with a high baseline level of training and the element's lesser dependence on anticipation. The greatest growth was recorded in the anticipation of the direction of the strike: 22.3% in the EG ($d=1.12$ – a very large effect) versus 7.9% in the CG. This result was achieved through video analysis and cognitive exercises designed to develop perceptual skills.

The rates of improvement in key indicators varied. Perceptual-cognitive metrics improved first, while tactics and shot reception developed linearly. The process of mastering the serve reception, following

a prolonged latent period, demonstrated rapid acceleration. In real match conditions, the EG liberos averaged 4.7 successful defensive actions per set, which significantly exceeded the CG's results.

Conclusions. The results of the pedagogical experiment indicate that the traditional training algorithm for liberos yields only a modest improvement (5–10%). The integrated approach developed in this study led to a statistically significant improvement in all measured indicators, with a substantial effect size.

In the experimental group, during the testing of the author's methodology, the effectiveness of receiving an attacking hit increased by 14.7%, and that of serving by 9.3%. The pronounced dynamics of tactical literacy (18.2%) and anticipation (22.3%) deserve special attention. The greatest effectiveness was achieved in anticipation and tactics, which confirms the dominant role of cognitive development in the structure of professionally significant qualities of a libero at the stage of athletic improvement.

In the initial stages of training, perceptual-cognitive indicators demonstrate accelerated improvement, which subsequently serves as the foundation for technical and tactical improvement. This pattern is a fundamental factor in planning training cycles. Video analysis of competitive performance has proven its effectiveness in developing tactical thinking and minimizing technical errors among volleyball players. The proposed methodology effectively adapts to competitive conditions, under which players in the experimental group demonstrated higher effectiveness in defensive actions.

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Technical training methodology for qualified table tennis athletes

UDC 796/799

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Abstract

Objective of the study is to theoretically develop and experimentally test the effectiveness of a method for technical training of qualified athletes involved in table tennis at the stage of improving sports skills using a large number of balls.

Methods and structure of the study. To solve the set tasks and achieve the set goal, the work used the analysis of scientific and methodological literature, pedagogical testing, pedagogical experiment, mathematical and statistical methods.

Results and conclusions. The developed methodology of technical training of athletes using the BKM method in the training process allows to significantly increase the density of technical actions, improve coordination of movements and develop the ability to quickly respond in multitasking conditions.

Keywords: *table tennis, high ball method, technical training, technical training.*

Introduction. With a large variety of motor activity systems and sports, each direction has its own characteristics. Considering table tennis, we can talk about a complex coordination sport that requires "fine tuning" of the athlete [2, 4, 5, 7].

Technical preparedness of athletes is of great importance for achieving sports results. For this purpose, technical preparation in table tennis includes a diverse combination of means and methods [1].

When practicing individual strikes, stances, and movements, it is necessary to combine them with each other and at the same time take into account changing conditions, including the technical and tactical actions of the opponent or sparring partner.

Scientists and practitioners (Barchukova G.V., Matytsin O.V., Laptev A.I., Pyatereva V.A., Gimaldinova E.S. and others) note the positive use of the method of a large number of balls in the training of table tennis athletes. This method allows you to regulate not only the speed of performing technical elements, but also to vary the length of the ball's flight [8].

More and more often, scientific studies are being conducted on the use of the large number of balls method to solve various problems, including the tech-

nical training of athletes. [3, 6]. At the moment, it is relevant to review the methods of improving technical training in table tennis using the method of a large number of balls.

Objective of the study is to theoretically develop and experimentally test the effectiveness of a method for technical training of qualified athletes involved in table tennis at the stage of improving sports skills using a large number of balls.

Research objectives:

1. Conduct an analysis of scientific and methodological literature on the research problem;
2. Develop and theoretically substantiate a methodology for technical training of athletes at the stage of improving sports skills with a large number of balls;
3. Experimentally substantiate the effectiveness of the developed methodology.

Methods and structure of the study. The work uses: analysis of scientific and methodological literature, pedagogical testing, pedagogical experiment, mathematical and statistical methods.

From September 2023 to April 2025, a study was carried out in the city of Kazan on the basis of MBI "ORSS" "Idel" on table tennis



For the practical implementation of the developed methodology, an experimental group (5 people) and a control group (5 people) were created, allowing for comparison of the results. The participants are table tennis athletes at the stage of improving their sports skills.

Results of the study and discussion. The period of application of the developed method was 26 microcycles of the preparatory stage. Taking into account the level of preparedness of the experiment participants, all selected technical elements and combinations were complicated

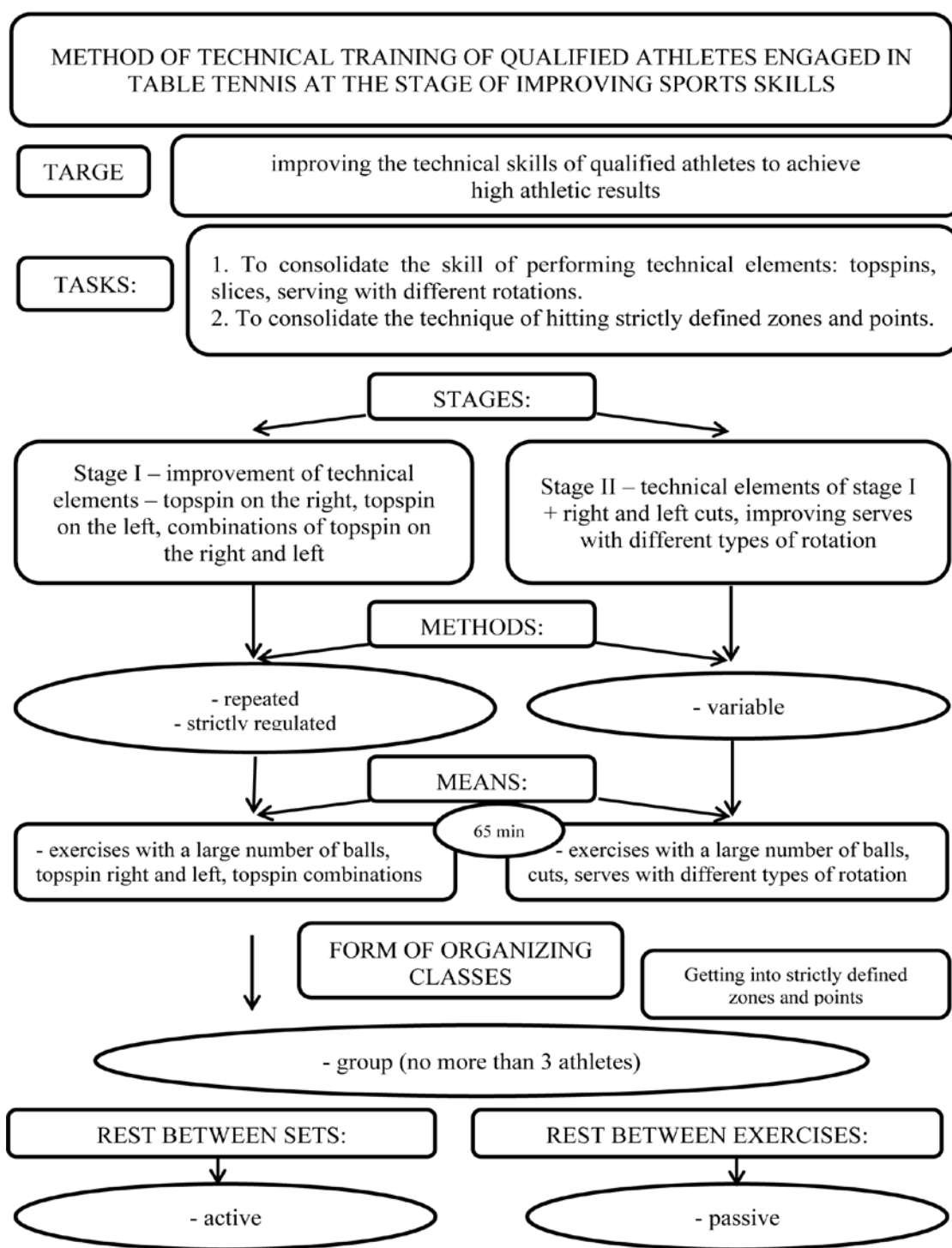


Figure 1. Model of the methodology of technical training of qualified athletes involved in table tennis at the stage of improving sports skills using a large number of balls



Table 1. Basic technical exercises (without complications)

	1st task The coach directs the ball with a bottom spin to the left corner of zone II; The athlete responds by cutting from the left diagonally to zone III.		2nd task The coach directs long balls with topspin to zone III of the left corner; The athlete responds with a topspin from the left diagonally to zone III.
	3rd task The coach directs long balls with topspin to zone III of the right corner; The athlete responds with a topspin from the right diagonally to III.		4th task The coach directs short balls with bottom spin to the right corner of zone II; The athlete responds with a diagonal cut from the right to zone III.
	5th task The coach directs the balls with topspin to zone II of the left corner; The athlete responds with topspin from the left straight to zone III.		6th task The coach directs the balls with topspin to zone II of the right corner; The athlete responds with topspin from the right straight to zone III.
	7th task The coach directs the balls with bottom spin to the left corner of zone II; The athlete responds with a left cut straight to zone II.		8th task The coach directs the balls with bottom spin to the right corner of zone II; The athlete responds with a cut from the right straight to zone II.

Note: T - trainer; C - athlete. The exercise is performed in two series. The duration of one series is two minutes.

by changing the speed of serving the balls or the flight length.

The selected means were divided into 4 groups of complexity, a certain focus, which were combined with each other in a logical sequence (Figure 1).

At the first stage, exercises aimed at performing single technical actions were selected. At the second stage, combinations aimed at improving movement during technical actions were added. Exercises aimed at improving the change in the trajectory of the sword

flight were added at the second and third stages in the amount of six. At the same time, 4 exercises remained from the first group.

At the third stage, a combination of exercises is performed: two from the first and second groups in one series and 4 from the 3rd group (two series are performed). A large number of exercises with arbitrary elements predominate in the fifth and sixth stages.



Table. Indicators of technical preparedness of subjects in the control and experimental groups at the beginning and end of the experiment

Exercises	Standard	$\bar{X} \pm S_x$ – CG (beginning of the experiment)	$\bar{X} \pm S_x$ – CG (end of experiment)	$\bar{X} \pm S_x$ – EG (beginning of the experiment)	$\bar{X} \pm S_x$ – EG (end of experiment)
1. Topspin Right Diagonal (number of times)	45 times	37,2±2,3	41,3±1,8	37,5±2,3	45,1±1,6
		p<0,01 (3,1)		p≤0,01 (0,5)	
2. Topspin left diagonal (number of times)	45 times	36,7±2,8	39,2±1,5	37,4±3,0	42,5±1,8
		p>0,01 (2)		p≤0,01 (4)	
3. Combination of right and left roll into the right corner (number of times)	35 times	26,7±1,5	30,0±1,3	26,5±1,8	35,6±1,7
		p<0,01 (1,9)		p≤0,01 (5)	
4. Combination of right and left roll into the left corner (number of times)	35 times	25,6±1,7	28,4±1,3	24,8±1,9	35,9±1,5
		p<0,01 (1,5)		p≤0,01 (4,5)	
5. Left diagonal cut (number of times)	25 times	15,3±1,3	17,8±1,1	15,1±1,0	22,7±1,5
		p>0,01 (1,5)		p≤0,01 (6)	
6. Cut right diagonally (number of times)	25 times	16,2±1,3	18,9±1,0	17,1±1,2	25,4±1,2
		p>0,01 (4,5)		p≤0,01 (4)	
7. Forehand topspin Serve from 10 (number of times)	10 times	4,5±0,9	5,0±0,9	5,7±0,8	10±0,8
		p>0,01 (1,8)		p≤0,01 (3,5)	
8. Backhand topspin serve in a set of 10 (number of times)	10 times	4,1±1,0	6,2±0,9	4,0±0,8	7,9±1,3
		p>0,01 (1,3)		p≤0,01 (3,2)	
9. Forehand serve with (underspin) out of 10 (number of times)	10 times	6,7±0,9	8,1±0,7	6,4±1,0	10±1,1
		p>0,01 (1,5)		p≤0,01 (4,5)	
10. Backhand serve (underspin) out of 10 (number of times)	10 times	5,83±1,1	7,5±1,1	5,6±1,0	10,2±1,0
		p>0,01 (1,7)		p≤0,01 (5)	

Table 1 shows examples of exercises assigned to the first group.

This method took up 30% of the time of one training session. Training sessions were held 5 times a week for 180 minutes.

Each task requires a planned response. In this case, the hit must be made not just in a certain direction, but in a specific point of the intended zone. Therefore, the table is visually divided into zones (the nearest one is along the net, the middle and far ones are parallel to the net). Six points are highlighted in the zones.

The readiness indicators of the subjects in the control and experimental groups at the beginning and end of the experiment are shown in Table.

Based on the data in Table, at the beginning of the experiment, athletes from the control and experimental groups have approximately the same mastery of the technique of the elements. In some exercises, the results of the control group are even slightly better than those of the experimental group. However, not a single indicator (average for the sample) reached the standard. The Mann-Whitney U-criterion was used to

process the athletes' results. The results for ten tests at p<0.01 are in the insignificance zone, unreliable, which indicates that the samples are equal.

At the end of the pedagogical experiment, the test results of the control group athletes improved, but none of the indicators reached the standard. In the experimental group, the norm was reached in exercises 1,3,4,6,7,9,10, and in exercises 2,5 they approached the norm (Table).

For example, at the beginning and end of the experiment, the CG result of "Ex. 3" was 26.7±1.5 times and 30±1.3 times, and the result of "Ex. 4" was 25.6±1.7 and 28.4±1.3, respectively. The values of the CG results improved by 3.3 times and 2.8 times, respectively. In the EG, the results were reliable, in "Ex. 3" at the beginning of the experiment the results were - 26.5±1.8 times, at the end - 35.6±1.7 times. In "Ex. 4" in the EG, with the standard of 35 times, the data were 24.8±1.9 times and 35.9±1.5 times. Which amounted to an increase of 9.1 times and 11.1 times, respectively (Table).

Analyzing the data of exercise 10 (serve from the



left – lower rotation) we can state the increase in the control group, which was 1.7 times with the initial average value of 5.8 ± 1.1 times. In the same exercise the increase in the experimental group was 4.4 times. The effectiveness of the method is confirmed by the increase in the indicators of technical actions of athletes.

Conclusions. Having analyzed the scientific and methodological literature on the topic of the study, we identified the need to use the BKM method during the training process in order to improve the level of technical preparedness of athletes.

The developed method of technical training of athletes using the method of a large number of balls in the training process allows to significantly increase the density of technical actions, improve coordination of movements and develop the ability to quickly respond in multitasking conditions.

Based on the work carried out and data analysis, the results obtained in the experimental group are significantly higher than in the control group.

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Motivation features of tennis players aged 10-12

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Abstract

Objective of the study is to optimise the educational and training process of young tennis players aged 10-12 based on the study of the features of their motivation.

Methods and structure of the study. Analysis of scientific and methodological literature, questionnaires and surveys of athletes, coaches, as well as parents of children involved in tennis, pedagogical experiment, methods of mathematical statistics. The study was conducted in 2023-2026 at tennis centres and sports schools in Moscow. 58 people took part in the survey and questionnaire, including 24 parents and 8 coaches, and the experimental work involved a group of 14 tennis players.

Results and conclusions. The dynamics of motivation features of young tennis players aged 10-12 and their parents were analysed in comparison with analogous data of tennis players under 10 years of age and aged 12-14 and older. The research results make it possible to use the obtained information not only directly in sports training, but also in everyday life, during the daily pedagogical process of educating the younger generation. Moreover, the systematisation of the obtained results makes it possible to make the preparation process continuous, smoothly transitioning to the next stage of development, using general principles to ensure better understanding and interaction with the player at each stage of this development.

Keywords: *tennis players aged 10-12, parents, coaches, motivation dynamics, participation in competitions.*

Introduction. The main feature of sports motivation is its direct influence on the performance of the athlete's activity. At the age of 10-12, tennis players begin to actively participate in official competitions of the Russian Tennis Tour. Participation in intense competitive struggle leaves an imprint on the motivation of young tennis players. Accounting for the occurring changes requires from the coach the introduction of corrections in the training process, relationships with the parents of students and, of course, with the young tennis players themselves.

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and sports schools in Moscow. 58 people took part in the survey and questionnaire, including 24 parents and 8 coaches, and the experimental work involved a group of 14 tennis players.

Results of the study and discussion. The relevance of our study is determined by the necessity of identifying the features of motivation of young tennis players aged 10-12 at the difficult moment of the beginning of active participation in Russian, and for many, international competitions. Moreover, on this path, interaction in the "triangle" coach-athlete-parents becomes particularly significant [1, 3]. Together they seek paths, methods and means of optimising their educational-training and competitive processes, as well as organising everyday communication. By the age of 10-12, tennis players have already covered a fairly long and not easy sporting path, during which a noticeable change in views and motives occurs, not only among athletes, but also among their coaches and, especially, parents, therefore it is important to identify the features of motivation of young tennis play-



ers aged 10–12 in comparison with analogous data of tennis players under 10 and at the age of 12–14 and older.

At each age, there are predominantly main motives, namely:

- Age up to 10 years – the main motive is sports-cognitive
- Age 10-12 years – the main motive is love for tennis and self-assertion
- Age 12-14 and older – the main motive is achievement of success.

Accounting for the occurring changes requires from the coach the study of individual features of students, the introduction of corrections in the training process, relationships with the parents of students and, of course, with the young tennis players themselves.

During the pedagogical experiment, directly with the experimental group, work on identifying and forming motives during competitive and training activity was conducted continuously for 6 months.

Twice a week, conversations were held in which children and parents were told [4, 5]:

- about the current and prospective tasks of their training and competitive process,
- interesting facts not only about the life and sporting fate, amusing and instructive stories from the lives of great tennis players, but also stories about difficulties encountered by them on the path to success,
- occurring situations with their peers-tennis players during training and competitions.

Particular attention was paid to the formation of professional norms of sporting behaviour on the court and off it.

In the process of training sessions, a competitive component was actively introduced, stimulating not only interest but also forming, under training process conditions, correct motives, the aspiration and ability to overcome stressful competitive situations, to adapt

more quickly to the tense atmosphere of competitive struggle, to enjoy rivalry, and to better understand the meaning of playing on score. Moreover, parents were actively involved in the analysis of arising situations. For coaches, this nature of training is necessary for a deeper understanding of the motives behind the student's actions, individual construction of training, increasing the effectiveness of managing the player both during the game and during the process of their preparation [2, 3].

Conclusions. All the obtained information was analysed jointly with the parents of young tennis players. The results of the work conducted provide grounds to consider that the level of motivation among children, parents and coaches significantly increased during the experimental work.

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Assessment of coordination abilities as a criterion for selecting children at the stage of initial training in the Latin American dance sports program

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Abstract

Objective of the study is to substantiate the importance of assessing coordination abilities as a key criterion for selecting children at the stage of initial training in the Latin American dance sports program.

Methods and structure of the study. The study was conducted on the basis of the Huainan Art School "Shiji". 40 children (7-10 years old) took part in it the initial training stages, which were divided into experimental (EG, n=20) and control (KG, n=20) groups, comparable in baseline level.

Results of the study and discussion. A survey of specialists showed that coordination and motor skills are the most important selection criterion. The average importance score was 4.87 ± 0.35 out of 5, which corresponds to the first rank among all the proposed criteria

This article examines the problem of substantiating the selection criteria at the stage of initial training for those involved in dance sports in the Latin American program. Based on the analysis of scientific and methodological literature, an expert survey of specialists (n=15) and the results of a pedagogical experiment (n=40), it is proved that coordination and balance are the priority criteria for the prospects of dancers.

It is concluded that it is necessary to move from the traditional assessment of general physical fitness to a multifunctional profile, where coordination abilities play a system-forming role.

Keywords: *dance sports, Latin American program, initial training, sports selection, coordination abilities, selection criteria.*

Introduction. The modern system of training sports reserves in dance sports requires a review of selection approaches at the initial training stage. The Latin American program is particularly difficult. Its specificity is determined by the high demands on coordination of movements, the speed of support change, vestibular stability and the ability to accurately rhythmic pattern. As V.P. Guba and L.P. Sergio rightly point out, selection is not a one-time procedure, but a comprehensive pedagogical management process aimed at identifying a child's compliance with the requirements of a sport.

However, an analysis of the literature has shown that traditional approaches to selection are often limited to tests of general physical fitness (GFS), which do not fully reflect the complex coordination nature of dance sports. This creates a contradiction between the prac-

tice's need for objective criteria and the insufficient development of evaluation systems that take into account the structure of the competitive result. According to the WDSF judging model, the quality of performance in a Latin American program is determined not only by technique, but also by musicality and partnership, which are based on coordination abilities.

Objective of the study is to substantiate the importance of assessing coordination abilities as a key criterion for selecting children at the stage of initial training in the Latin American dance sports program.

Methods and structure of the study. The study was conducted on the basis of the Huainan Art School "Shiji". 40 children (7-10 years old) took part in it the initial training stages, which were divided into experimental (EG, n=20) and control (KG, n=20) groups, comparable in baseline level.



A set of methods was used to solve the tasks set:

1. Analysis of scientific and methodological literature;

2. A survey of specialists (n=15) – coaches and referees, to identify the significance of various criteria;

3. Pedagogical testing, which includes a special battery of tests, in which coordination tests occupied a central place.:

- Static balance: standing on one leg (sec);
- Dynamic balance: walking along the "track to track" line (number of errors);
- Coordination ladder: time and accuracy of execution of a given pattern;
- Rhythm test: playing a rhythmic pattern with claps/steps;

4. Pedagogical supervision based on a standardized chart, assessing musical and rhythmic involvement, learning ability and control of the corps;

5. Pedagogical experiment (8 weeks) to test the prognostic value of the selected criteria;

6. Methods of mathematical statistics (Student's t-test, Spearman correlation analysis).

Results of the study and discussion. Expert assessment of the importance of coordination abilities

A survey of specialists showed that coordination and motor skills are the most important selection criterion. The average importance score was 4.87 ± 0.35 out of 5, which corresponds to the first rank among all the proposed criteria (Table 1).

The Kendall concordance coefficient ($W=0.76$; $p < 0.01$) confirmed the high consistency of expert opinions. This proves that for the successful development of the Latin American program, the ability to maintain stability, accurately adjust movements and control the body is fundamental.

The results of the pedagogical experiment

At the ascertaining stage, no significant differences were found between EG and CG. During the experiment, the EG was completed using the developed methodology, where special attention was paid to coordination indicators. At the end of the formative stage, statistically significantly higher dynamics was

observed in the EG for all coordination indicators (Table 2).

The increase in indicators in EG was 34% (static balance), 50% (dynamic balance) and 24% (coordination ladder), while in CG the changes were insignificant. This confirms that the initial selection of children with higher coordination abilities creates a solid foundation for rapid progress.

Predictive validity of coordination criteria

Correlation analysis showed that the initial indicators of coordination and balance have a high positive relationship with the final expert assessment of Latin American dance techniques (Rumba-walk and Cha-cha chasse) at the end of the experiment (Table 3).

The high correlation (r from 0.65 to 0.71, $p < 0.01$) indicates that the level of development of coordination abilities at the initial training stage is a reliable predictor of future success in mastering the specific technique of the Latin American program.

The results of the study are consistent with the data of other authors, in particular with the works of N.V. Putintseva and A. Zabrocka, who also pointed to the leading role of coordination in the structure of the training of young dancers. Our study complements these data, demonstrating not only the high significance, but also the predictive power of coordination tests for the Latin American program.

While flexibility or speed-strength qualities can develop during training, basic coordination abilities and vestibular stability are largely genetically determined and are more difficult to correct at an older age. Therefore, their assessment at the stage of initial training is critically important to prevent a situation when a child with an insufficient level of coordination faces insurmountable difficulties in mastering dynamic rotations and rapid changes of support in samba, cha-cha-cha or jive.

The practical significance of our conclusion lies in the fact that trainers are recommended to include in the battery of tests during selection not only the standards of the OFP, but also mandatory tests for static and dynamic balance, as well as simple rhythmic

Table 1. Expert assessment of the significance of the selection criteria (n=15)

Rank	Selection Criteria	Average score (1-5)
1	Coordination and balance	4.87 ± 0.35
2	Musical and rhythmic	24.80 ± 0.41
3	Flexibility	4.67 ± 0.49
4	Technical predisposition	4.60 ± 0.51
5	Speed-strength qualities	4.40 ± 0.63

Table 2. Dynamics of coordination indicators ($M \pm \sigma$)

Indicator	Group	Before experiment	After experiment	t	p
One-leg stand(sec)	EG	18,4±4,2	24,7±4,0	4,38	<0.01
	CG	18,9±4,6	21,1±4,3	1,71	>0.05
Walking along the line(errors)	EG	3,6±1,1	1,8±0,8	6,04	<0.01
	CG	3,4±1,0	2,9±0,9	1,65	>0.05
Coordination ladder(sec)	EG	13,8±1,5	10,5±1,2	5,84	<0.01
	CG	13,6±1,4	12,4±1,3	1,98	>0.05

Table 3. Correlation of coordination indicators with final technical readiness (r)

Indicator(test)	Correlation coefficient(r)	Strength of relationship
One_leg stand(static balance)	0,68	High
Walking along the line(dynamic balance)	0,71	High
Coordination ladder	0,65	High

tasks. This will make it possible to form initial training groups of children with a potentially higher "coordination readiness" to master the Latin American program.

Conclusion. The conducted research allows us to draw the following conclusions:

1. Coordination abilities (balance, stability, precision of movements) are the priority selection criteria for practicing dance sports in the Latin American program at the initial training stage. This is confirmed by the expert opinion (rank 1) and the results of the pedagogical experiment.

2. The indicators of static (standing on one leg) and dynamic (walking in a line) balance have high predictive validity ($r \geq 0.68$) in relation to the future technical readiness of young dancers.

3. A comprehensive assessment of coordination abilities makes it possible to form initial training groups with higher learning potential, which is manifested in a more pronounced positive trend in mastering the basic elements of the Latin American program over 8 weeks of training.

A comprehensive diagnostic technique is presented, including tests for static and dynamic balance, a coordination ladder, and a rhythm test. The results of the formative experiment showed that targeted selection based on coordination indicators contributes to a more pronounced positive trend in mastering the basic techniques of the Latin American program and has a high predictive validity ($r=0.68$).

Thus, the inclusion of specialized coordination tests in the selection system is a prerequisite for improving the objectivity and effectiveness of initial training in Latin American dance sports.

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Parameters of variability in the execution of the serve by skilled volleyball players

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Abstract

Objective of the study is to identify the parameters of variability in the execution of serves by skilled volleyball players.

Methods and structure of the study. The following parameters were assessed during the study: dynamometric data, the accuracy of muscle force differentiation and the magnitude of their deviation from the calculated value, agility coefficients in running and jumping, the ability to distinguish time intervals, as well as the endurance of the nervous system and its ability to switch to movements performed at different speeds. Serving effectiveness was assessed based on the type of serve (precision serve, power serve, “hybrid” serve). Ten matches of leading teams were analyzed using the professional software Data Volley 4Pro. The study subjects were 12 male athletes holding the qualifications of Candidate Master of Sports and Master of Sports, participants in the Russian Volleyball Championship.

Results and conclusions. 1. It was established that for precision serves, the key parameters are the differentiation of muscular effort (25% and 50% of maximum) and the difference in time intervals (10 and 30 seconds). 2. It was determined that for power serves, the determining indicators are the jump agility coefficient, the level of nervous system endurance, and its ability to switch to movements at different speeds. 3. It was found that for hybrid serving, the determining factors are parameters of jumping agility, maximum hand strength, accurate discrimination of time intervals (10, 30, and 60 seconds), differentiation of muscular effort (75% of maximum), high levels of endurance, and the nervous system's ability to switch between movements at different speeds.

Keywords: *parameters, serve variability, competitive volleyball players.*

Introduction. According to statistics from the Russian championship, winning teams generally demonstrate higher levels of serve complexity and effectiveness than their opponents [4]. Each player chooses a serve type individually, based on an assessment of their own physical qualities, functional capabilities, and anthropometric parameters [2]. This, in turn, raises the bar for an athlete's personal readiness when executing a serve [5]. Nevertheless, the scientific literature on volleyball lacks data regarding the preparedness of skilled athletes in the context of executing serves using different techniques.

The current trend in volleyball development is characterized by a shift in priorities: the planning and power serves are being replaced by the hybrid serve [3]. The introduction of the hybrid serve requires players to master additional technical skills [1].

To adequately assess players' readiness for serving, a detailed study is required to determine which specific fitness parameters influence the execution of a serve using one method or another.

Objective of the study is to identify the parameters of variability in the execution of serves by skilled volleyball players.

Methods and structure of the study. The following parameters were assessed during the study: dynamometric data, the accuracy of muscle force differentiation and the magnitude of their deviation from the calculated value, agility coefficients in running and jumping, the ability to distinguish time intervals, as well as the endurance of the nervous system and its ability to switch to movements performed at different speeds. Serving effectiveness was assessed based on the type of serve (precision serve, power serve, ‘hybrid’ serve). Ten matches of leading teams were analyzed using the professional software Data Volley 4Pro. The study subjects were 12 male athletes holding the qualifications of Candidate Master of Sports and Master of Sports, participants in the Russian Volleyball Championship.

Results of the study and discussion. To achieve this objective, data were collected and analyzed to assess



the performance of highly skilled volleyball players when executing jump serves using various techniques (Fig.).

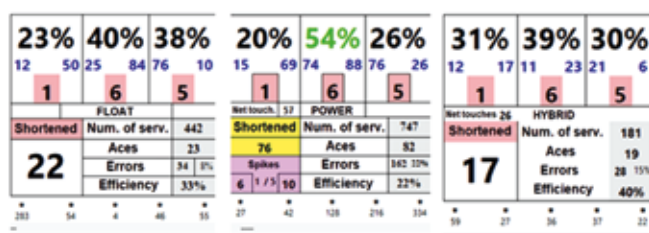


Figure 1. Performance parameters for different feeding methods

It was found that in the competitive setting of the Russian Volleyball Championship, the frequency of the hybrid serve is lower than that of the power serve and the float serve; however, the hybrid serve is the most effective.

During the testing, the athletes' physical fitness levels were assessed. The results are presented in Table 1.

The results of the study show that the variability in serve execution is determined by a combination of specific aspects of the functional fitness of skilled volleyball players.

For a successful precision serve, a high level of running agility, fine differentiation of muscular effort (25% and 50% of maximum), and high accuracy in distinguishing time intervals (10 and 30 seconds) are significant. In contrast, the precision serve corresponds to low values of maximum hand strength, nervous system endurance, and the ability to switch between movements of different speeds.

The drop serve is used by highly skilled players as

an occasional tactical tool, since in high-level teams, receiving such serves does not pose serious problems. Therefore, highly skilled athletes use planning serves on an individual basis.

Executing a power serve is associated with an increase in the jumping agility coefficient, an increase in maximum hand strength, and an increase in the endurance of the nervous system and its ability to quickly switch between movements of different speeds.

The key parameters for this serving method are the ability to modulate muscle effort at 75% of maximum capacity, as well as the differentiation of time intervals of 10 and 30 seconds. For highly skilled volleyball players, the power serve is the primary technical and tactical method of putting the ball into play.

It has been found that the hybrid serve, which requires the player to adjust their movements during the unsupported phase, is characterized by even higher values of maximum hand strength and the jump agility coefficient, as well as more precise differentiation of each of the three measured time intervals and differentiation of muscle effort at 75% of maximum. In addition, this serving technique is associated with the highest indicators of nervous system endurance and its ability to switch between movements at different speeds.

An analysis of the players' readiness parameters shows that the hybrid serve is the most difficult to execute. It requires higher performance levels from the players, which collectively reflect their technical and tactical mastery and allow them to increase the percentage of points won directly from the serve in competitive conditions.

Table 1. Test results for elite athletes using different serving techniques (n=12)

Parameter	$\bar{X} \pm S_x$		
	Precision serve	Power serve	Hybrid serve
Agility coefficient during running (units)	1,5±0,08	1,48±0,02	1,58±0,04
Agility coefficient during jumping (units)	0,61±0,04	0,64±0,02	0,67±0,02
Differentiation of the 10-second time interval	9,83±0,39	9,85±0,30	9,92±0,40
Differentiation of the 30-second time interval	30,75±1,46	29,86±0,70	30,05±0,77
Differentiation of the 60-second time interval	63,95±22,48	64,95±0,73	60,62±1,91
Dynamometry, max. force (kg)	39,33±0,82	47,56±0,80	55,46±1,68
Differentiation of muscle effort at 75% of max. force (kg)	27,56±1,27	32,43±1,18	42,2±0,49
Calculated value / deviation (kg)	29,49 / -1,91	35,67 / -2,56	41,59 / +0,61
Differentiation of muscle effort at 50% of max. force (kg)	21,33±0,33	28,19±1,02	31,03±1,66
Calculated value / deviation (kg)	19,66 / +1,66	23,78 / +4,41	22,73 / +3,3
Differentiation of muscle effort at 25% of max. force (kg)	12,63±0,88	21,31±1,20	22,53±0,39
Calculated value / deviation (kg)	9,83 / +2,79	11,89 / +9,42	13,86 / +8,66
Tapping test, change in movement speed (counts per minute)	50,32±0,60	60,05±0,62	62,28±0,58
Tapping test, max. movement speed (counts per minute)	56,33±0,89	63,33±0,50	64,44±0,38



Table 2. Variability of parameters when using different feeding methods

Indicators	CMS-level athletes, Vi (S/M) (n=12)		
	Precision serve	Power serve	Hybrid serve
Running agility coefficient (units)	0,06	0,02	0,02
Jumping agility coefficient (units)	0,08	0,05	0,04
Differentiation of the 10-second time interval	0,05	0,03	0,03
Differentiation of the 30-second time interval	0,06	0,02	0,02
Differentiation of the 60-second time interval	0,048	0,01	0,01
Dynamometry, max. force (kg)	0,027	0,021	0,021
Differentiation of muscle effort at 75% of max. force (kg)	0,054	0,04	0,04
Differentiation of muscle effort at 50% of max. force (kg)	0,02	0,04	0,04
Differentiation of muscle effort at 25% of max. force (kg)	0,87	0,07	0,07
Tapping test, change in movement speed (counts per minute)	0,01	0,01	0,01
Tapping test, max. movement speed (counts per minute)	0,02	0,01	0,01

Note: Vi – the variability of changes in the parameter

The data obtained allow us to specify the key parameters and confirm the hypothesis: if these parameters are insufficiently developed, players either do not use the hybrid serve at all or execute it with serious technical and tactical errors. The variability of the studied parameters among skilled players is presented in Table 2.

It has been determined that as the technical complexity of the serve increases, the variability of all parameters of player fitness decreases. The most pronounced decrease in the variability of the jump agility coefficient was observed during the hybrid serve – the most complex technique.

An analysis of the fitness of skilled volleyball players also shows that it is incorrect to claim that any single indicator has a decisive influence on the quality of the serve, regardless of the method used. To adequately assess players' readiness to execute a serve using a particular method, a comprehensive approach is necessary, which involves taking into account, at a minimum, such key parameter as: running and jumping agility (coefficient), maximum hand strength, nervous system endurance and its ability to switch between movements at different speeds, as well as the ability to differentiate muscle effort and time intervals.

The study identified parameters indicating the need to develop individualized training methods for different types of serves in volleyball. For the coaching staff, the results are valuable in terms of planning training content related to selecting a serve type for each specific athlete.

Conclusions. 1. It has been established that, for accuracy serves, the key parameters are the differentiation of muscle effort (25% and 50% of maximum) and the difference in time intervals (10 and 30 seconds). 2. It has been determined that for power-oriented serving, the

determining indicators are the jumping agility coefficient, the level of nervous system endurance, and its ability to switch to movements at different speeds. 3. It was found that for hybrid serving, the determining factors are parameters of jumping agility, maximum hand strength, accurate discrimination of time intervals (10, 30, and 60 seconds), differentiation of muscular effort (75% of maximum), high levels of endurance, and the nervous system's ability to switch between movements at different speeds.

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Effectiveness of different serve types and their influence on reception quality and first attack performance of the opponent (based on Women's Superleague teams)

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Abstract

The relevance of the study stems from the evolving role of the serve in elite women's volleyball: once a mere means of putting the ball into play, it has become a tool for controlling the opponent's attacking patterns, yet the conventional "ace versus error" metric fails to capture this tactical effect.

Objective of the study is to quantify the influence of the opposing team's serve-type composition on reception quality, attacking action characteristics, and rally outcome in Russian Women's Superleague clubs.

Methods and structure of the study. Methods comprised pedagogical observation and video analysis of 1,436 rallies involving 22 athletes from VC Dynamo Moscow and VC Minchanka; Pearson's χ^2 test, Cramer's V, odds ratios (OR), and Student's t-test were employed.

Results and conclusions. Results indicate that a variable serve composition yields a significantly higher proportion of disrupted opponent receptions, greater suppression of quick attacks, and a higher serve-rally win rate, despite no significant difference in the aggregate serve efficiency index.

Keywords: volleyball, serve, reception, attacking actions, competitive activity, Superleague, tactical training.

Introduction. The serve in elite women's volleyball increasingly performs the function of tactical pressure, and not merely the introduction of the ball into play [1, 3]. This evolution gives rise to a methodological contradiction: the conventional assessment of the serve by the "ace-error" ratio does not capture its influence on the quality of reception, the tempo of the set and the character of the opponent's attack. Foreign data confirm that reception is the dominant predictor of attack effectiveness; however, the contrast between "variable" and "monotype" serve composition and its projection onto the entire rally chain have not been examined. On the material of the Russian Superleague, such models are absent.

Objective of the study is to quantify the influence of the opposing team's serve-type composition

on reception quality, attacking action characteristics, and rally outcome in Russian Women's Superleague clubs.

Methods and structure of the study. 1,436 rallies were recorded in matches of VC Dynamo Moscow and VC Minchanka (22 athletes). The teams are contrasting in serve model and comparable in qualification. For each rally, the following were coded: serve type (planning / power jump / hybrid), reception quality (5-level scale), character and zone of attack, rally outcome. Pearson's χ^2 test, Cramer's V, OR with 95% CI, and Student's t-test were applied. Processing was performed using IBM SPSS 26.0.

Results of the study and discussion. The serve-type composition of the two teams differs fundamen-

tally ($p < 0.001$; Cramer's $V = 0.266$). Dynamo Moscow implements a variable model including power (12.7%) and hybrid (2.3%) serves alongside planning (85%), whereas VC Minchanka is almost entirely limited to the planning serve (99.4%). The distribution of serves by type is presented in Figure 1.

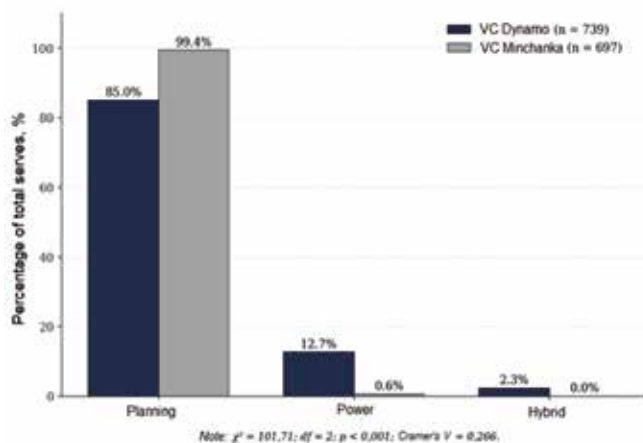


Figure 1. Distribution of serves by type in VC Dynamo and VC Minchanka teams

At the same time, the serve efficiency index of the teams does not differ statistically ($p = 0.406$) – the “equality paradox”, exposing the limitations of the one-dimensional metric. The tactical effect is revealed in subsequent links of the chain: the variable model ensures disrupted reception in 43.4% of rallies versus 33.5% with monotype, and reduces the proportion of the opponent’s quick attacks to 53.3% versus 61.2%. The serve-rally win rate for Dynamo Moscow is 44.65% versus 35.97% for Minchanka.

Serve type is associated with a redistribution of the opponent’s attack zones (Cramer’s $V = 0.210$; $p < 0.001$). Zone 4 remains the base for all serve types; however, the power serve doubles the proportion of attacks from zone 1 (13.8% versus 7.3%), while the hybrid serve triples the proportion of attacks from zone 3 (33.3% versus 14.9%) due to a reduction in attacks from zone 2 (Figure 2).

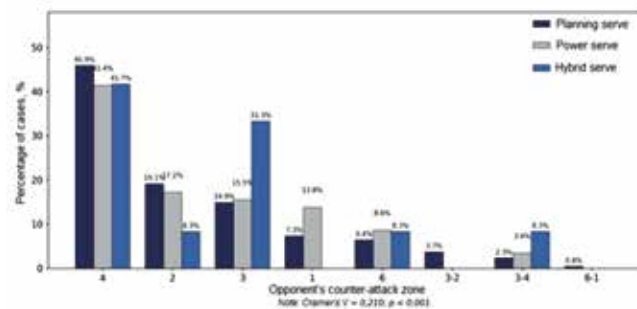


Figure 2. Distribution of opponent attack zones after different serve types

The relationship between reception quality and attack character is high (Cramer’s $V = 0.548$), confirming the determining role of reception in forming the attacking arsenal.

Conclusions. The variable serve composition of the opposing team statistically significantly exceeds the monotype model across three key parameters: disrupted reception, suppression of tempo attacks, and serve-rally win rate. The “equality paradox” of aggregate indices ($p = 0.406$) substantiates the transition to a multidimensional serve assessment incorporating reception and attack indicators of the opponent.

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Features of heart rate variability and heart rate in football referees of various qualification levels under competitive conditions

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Abstract

Objective of the study is to identify the features of heart rate variability and heart rate in football referees of various qualification levels under competitive conditions.

Methods and structure of the study. The study was conducted with football referees of various qualification levels who officiated matches of the Moscow City Championship and the Russian Championship among amateur football clubs. During pedagogical observations and pulse monitoring, heart rate and heart rate variability indicators were recorded for head referees and their assistants. A Polar H10 chest heart rate monitor was used for heart rate assessment, and the Elite HRV programme was used for heart rate variability analysis. Indicators were recorded before the match, during the game by pulse zones and after its completion.

Results and conclusions. The obtained data indicate a higher level of functional stability in qualified referees and allow the consideration of heart rate and heart rate variability indicators as informative criteria for assessing the special preparedness of football referees.

Keywords: football referees, competitive activity, heart rate, heart rate variability, functional state, physical preparedness, sports officiating.

Introduction. Modern football is characterised by high intensity of game activity and increased demands on the quality of officiating. Under these conditions, the professional activity of a football referee is accompanied by significant physical load, which is reflected in changes in heart rate and heart rate variability during the match [1, 2]. Against the background of fatigue, especially in the final stages of the game, the number of erroneous and missed decisions increases, which necessitates the study of functional reactions of the cardiovascular system in referees of various qualification levels. Heart rate and heart rate variability indicators enable the assessment of the level of motor activity, the degree of fatigue and the functional stability of the referee, making them informative criteria under competitive conditions [3, 4].

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Methods and structure of the study. The study was conducted with football referees of various qualification levels who officiated matches of the Moscow City Championship and the Russian Championship among amateur football clubs. During pedagogical observations and pulse monitoring, heart rate and heart rate variability indicators were recorded for head referees and their assistants. A Polar H10 chest heart rate monitor was used for heart rate assessment, and the Elite HRV programme was used for heart rate variability analysis. Indicators were recorded before the match, during the game by pulse zones and after its completion.

Results of the study and discussion. Analysis of heart rate indicators in head referees showed that the main portion of match time for qualified referees



officiating Russian Championship games fell within the range of 136–155 bpm and constituted 41.2% of total working time. For young beginning referees officiating Moscow City Championship matches, 35.5% of time was recorded in this same zone. At the same time, beginning referees spent more time in less intensive pulse zones, indicating somewhat lower motor activity compared with qualified referees. Meanwhile, for zones of 156–175 bpm and above 176 bpm, beginning head referees spent 4.5 and 0.7% of time respectively, whereas for qualified referees these indicators were 2.8 and 0.3%. This indicates that the activity of qualified referees is characterised by more stable work in aerobic and aerobic-anaerobic zones.

Heart rate variability indicators in head referees revealed substantial differences between groups. In beginning football referees, HRV after the match decreased from 77.3 to 57.2 ms, whereas in qualified referees the decrease was less pronounced – from 81.8 to 74.6 ms. The significant decrease in HRV in young referees indicates more pronounced fatigue and lower adaptive stability of the cardiovascular system to competitive load.

Analysis of heart rate in assistant referees showed that for qualified referees, 40.2% of match time fell within the range of 141–160 bpm, and 30.9% within the range of 121–140 bpm. For young beginning assistant referees, a different picture was observed: 39.5% of time they spent in the zone of 121–140 bpm, and the range of 141–160 bpm accounted for 27.6% of time. As with head referees, both qualified and beginning assistants spent the least time in the highest pulse zones. For qualified assistants, the range of 171–180 bpm accounted for 3.5% of time, and the zone above 181 bpm – 0.3%. For beginning assistants, these indicators were 1.7 and 0.1% respectively.

Conclusions. Football referees of various qualification levels showed differences in the nature of cardiovascular reactions under competitive conditions. Qualified referees perform a greater volume of work in zones of moderately high intensity, whereas beginning referees show a more pronounced decrease in heart rate variability after the match. The obtained data indicate a higher level of functional stability in qualified referees and allow the consideration of heart rate and HRV indicators as informative criteria for assessing the special preparedness of football referees.

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Methodological aspects of the conjugated execution of manoeuvres in the high-speed application of defensive and counter-attacking actions

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Abstract

Objective of the study is to identify the methodological aspects of the conjugated execution of manoeuvres in the high-speed application of defensive and counter-attacking actions.

Results and conclusions. The main stages of preparation for the formation of skills of conjugated execution of manoeuvres in the high-speed application of defensive and counter-attacking actions are identified. The main components of tactical interaction, sensorimotor corrections of motor actions in the training process are examined, for the automation of movement during switches from one action to another.

Keywords: *manoeuvring, combat interaction, effective action, conjugated execution of manoeuvres, technique elements, defensive and attacking actions.*

Introduction. The improvement of technical and tactical actions in combat sports during the preparation of highly qualified athletes is closely associated with the application of tactical manoeuvring.

Specialists in combat sports view manoeuvring as a conflict interaction between fighters, necessary for creating a favourable situation for executing an effective action and an unfavourable one for the opponent.

In athletes in combat sports during competitive activity, manoeuvring actions are formed spontaneously, and they apply them intuitively. Fighters competing at international competitions successfully execute complex manoeuvring, combining manoeuvres in combinations, but perform them unconsciously, without awareness of the tactical essence of these actions.

The successful use of manoeuvring skills in combination with other preparatory actions helps the athlete achieve a positive result in attacking and defensive actions. Tactical manoeuvring connects tactical and technical actions, including: movements, feint attacks, dashes, pushes, etc., all these actions force the opponent to react, expending energy, breaking in-

tentions, putting them in a state of confusion and as a result the fighter, using manoeuvrable combat management, gains an advantage for executing an effective action.

The combination of manoeuvres in combinations for executing defensive and counter-attacking actions is widely used in striking combat sports. In combat interaction, the use of prepared combinations enables the fighter to control the opponent's intentions, forcing them to act predictably.

The tactical significance of manoeuvring consists in disorienting the opponent, enabling the execution of impact while concealing one's own intentions and goals, through the creation or use of a favourable situation. Using manoeuvring skills, one can not only execute defensive but also carry out counter-attacking actions.

The main components of tactical interaction when improving the skills of defensive and counter-attacking actions are combinations of manoeuvres for combining elements of motor actions and switching from one action to another.



In the process of controlling motor actions of varying complexity, various levels of the nervous system are engaged, depending on the information received and the situations of combat confrontation. In the process of constructing complex motor actions of conjugated manoeuvring, direct and feedback connections between the brain and nervous system are engaged, constituting the basis for sensorimotor corrections of movement, the automation of which is formed in training activity.

Objective of the study is to identify the methodological aspects of the conjugated execution of manoeuvres in the high-speed application of defensive and counter-attacking actions.

Results of the study and discussion. Analysis of effective actions in tactical manoeuvring among athletes participating in international competitions in applied types of combat sports made it possible to determine the methods of conjugated execution of manoeuvres for the application of defensive and counter-attacking actions, and to form the stages of their preparation.

In the training process, when forming skills of conjugated execution of manoeuvres in the high-speed application of defensive and counter-attacking actions, we identify three main stages.

At the first stage, elements of the technique of defensive and attacking actions are practised, for the formation of the skill of application in confrontation, with the help of special training exercises.

The second stage involves combining manoeuvres in combinations, for the formation of the skill of high-speed execution of defensive and counter-attacking actions, with the application of conditionally-situational tasks.

At the third stage, the skill of switching in combinations from defensive and counter-attacking actions to repeated strikes or throws is formed. The practice of switching actions is performed using reflex reactions to impact or by external conditional signals. Thus, we form combat tactics by creating a favourable situation for the execution of effective actions, training fighters to recognise pre-signals of the beginning of counter-action or attack. Switching action in confrontation presupposes the timeliness of transition from one action to another in the minimum period of time without losing the advantage of a favourable position.

Conclusion. Methodological recommendations on the conjugated execution of manoeuvres in the high-speed application of defensive and counter-attacking actions using a combined approach showed positive dynamics of effective actions in competitive activity. This approach in the methodology of teaching the application of tactical manoeuvring made it possible to form the skills of combined actions in combinations, thus increasing the speed indicators of effective actions, which improves the quality of athlete preparation.

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Integrative approach to managing student sports movement at the university: a theoretical aspect

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Abstract

Objective of the study is to substantiate and develop the theoretical and programme content of an integrative approach to managing the student sports movement at the university and to recommend it for practical implementation.

Methods and structure of the study. The study was conducted from 2024 to 2026 at Siberian Federal University, Krasnoyarsk and at Krasnoyarsk State Medical University, Krasnoyarsk. The total sample size comprised 600 students in years 1-2. The experimental group consisted of 300 students from Siberian Federal University and 300 students of the control group from Krasnoyarsk State Medical University. The comprehensive theoretical and practical analysis made it possible to identify the main factors influencing the increase in activity and mass participation of the student sports movement at the university and to develop the theoretical content of the integrative approach to activating the sports movement among student youth at the university.

Results and conclusions. The conducted theoretical study contributed to the development of an integrative approach to activating the student sports movement, including the following organisational-pedagogical blocks: educational-health-improving, mass sports, individual-independent and control. Programme-methodological support for the integrative approach to managing the student sports movement at the university was also developed, containing the following practice-oriented sections: theoretical, practical, individual and diagnostic. The developed theoretical and methodological material of the integrative approach will contribute to increasing the mass participation and activity of the student sports movement in higher education.

Keywords: *integrative approach, management, students, sports movement, university, mass participation.*

Introduction. The President of the Russian Federation and the Government of the country have set the task of involving up to 80% of the Russian population in systematic physical culture and sport activities by 2030. At the same time, physical culture activities of the population represent a quantitative indicator of mass participation, while the qualitative indicator is the population's engagement directly in sport. Attracting the population, especially student youth, to mass sports activities, the transition from quantitative to qualitative indicators, is an important task for specialists in the field of physical culture and sport. The development of an integrative approach to forming the student sports movement in the country's universities was the objective of this work.

Objective of the study is to substantiate and develop the theoretical and programme content of an integrative approach to managing the student sports movement at the university and to recommend it for practical implementation.

Methods and structure of the study. The study was conducted from 2024 to 2026 at Siberian Federal University, Krasnoyarsk and at Krasnoyarsk State Medical University, Krasnoyarsk. The total sample size comprised 600 students in years 1-2. The experimental group consisted of 300 students from Siberian Federal University and 300 students of the control group from Krasnoyarsk State Medical University. For the organisation and conduct of the preliminary study, the following block of methods for collecting factual material was formed: analysis of scientific-methodological literature on the topic, systematisation of experimental material, modelling, interpretation, questionnaires, conversations, analysis of mass sports work at universities, monitoring of the sports movement at the university, overall percentage of students engaged in sports sections, analysis of students' preparedness for sporting activity, statistical analysis, and others.

The comprehensive theoretical and practical analy-



sis made it possible to identify the factors influencing the increase in activity and mass participation of the student sports movement at the university and to develop an experimental approach to activating the sports movement among student youth at the university.

Results of the study and discussion. Based on the results of the conducted theoretical study, an integrative approach was developed, the content of which is presented in Figure 1.

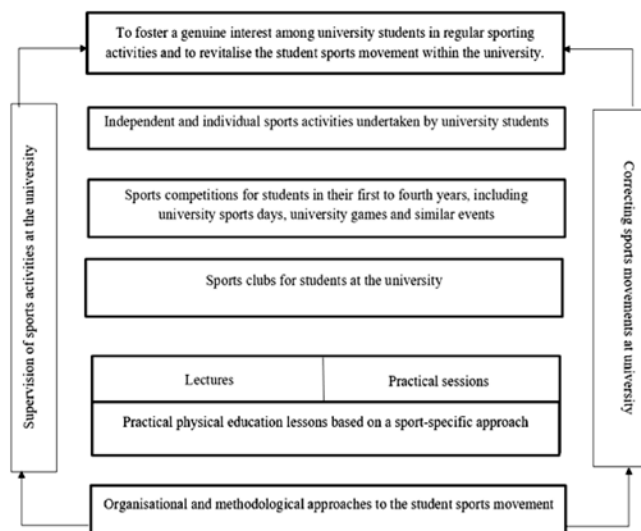


Figure 1 – Organisational-methodological forms of the integrative approach to managing the student sports movement at the university

To support the integrative approach, a programme was developed containing the following practice-oriented sections:

1. The educational-health-improving section includes: traditional academic-practical classes for students in the discipline 'Physical Culture and Sport,' which include a comprehensive theoretical course on the topic: 'Physical Culture and Sport for Students at the University,' as well as a practical course where students form practical skills and abilities in physical culture and sport. Also, during classes, physical education instructors motivate students towards the development of personal motor potential based on the choice of an individual sport; during physical education, a positive attitude towards systematic motor activity, a healthy lifestyle and behaviour is formed among young people.

2. The mass sports section includes: various sports competitions and mass physical culture and health-improving events among student youth directly at the university, as well as 'universiads,' various physical culture and sports movements at the city and re-

gional levels; all-Russian competitions, etc. This entire complex of mass sports events is aimed at maintaining the motor activity of young people; forming the need for active engagement in mass sports among students and sports culture; socialisation in society; the work of various sports sections by type of sport at the university is also carried out, students are motivated towards systematic sports training, and the significance of students' sports activities at the university is increased.

3. The individual-independent section is primarily aimed at forming students' personal motor culture and the need for systematic sporting activity. Promotion among students of the necessity of performing morning exercises; independent training in the chosen sport during free time; walks and runs outdoors; sports games with friends at specialised grounds; serving as a personal example of the results of sports practice for those around them.

4. The control-correction section includes: the number of students engaged in sports sections, the frequency of students' sports activities in the weekly cycle, the number of hours spent by students on organised sports activities, the percentage of students participating in various sports events, and others.

Such an integrative approach will generally contribute to the activation of the student sports movement at the university.

Conclusion. The developed theoretical and programme-methodological support for the integrative approach, based on the interrelationship of educational-health-improving, mass sports and individual-independent forms and means, makes it possible to more broadly cover, define, correct and activate the student sports movement in higher education.

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Psychophysical control in modern physical education of students at the university

UDC 796.015



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Abstract

Objective of the study is to justify and develop the content of psychophysical monitoring in physical education for university students as an innovative approach to the comprehensive management of the physical condition of today's student population in an educational setting, and to recommend its implementation in practice.

Methods and structure of the study. The study was conducted at Siberian Federal University in Krasnoyarsk. The sample size consisted of more than 1,200 first- through third-year students. Over the course of three years, psychophysical testing of students was conducted in the following areas: morphofunctional, psychological, cultural-educational, physical development, stress resistance, and physical education literacy. In total, more than 19 groups were analyzed, encompassing various indicators of the students' psychophysical condition. The collected data underwent mathematical processing by psychophysical condition categories, was systematized into tabular form, and levels of psychophysical readiness by category were developed, along with an integrated indicator of psychophysical readiness for university students.

Results and conclusions. The statistical data collected over three years across 19 blocks for assessing and monitoring students' psychophysical condition also made it possible to select and establish appropriate blocks for evaluating the psychophysical condition of today's student population. All of this, taken together, made it possible to develop levels of psychophysical condition (excellent, good, satisfactory, unsatisfactory, and low) in points across the following assessment blocks: morphofunctional, psychological, cultural-educational, physical development, stress resistance, and physical education literacy. A comprehensive indicator for assessing the psychophysical potential of university students was also developed. Such an innovative and comprehensive approach to evaluating the results of physical education for university students contributes to the expansion and modernization of the curricular and target content of the general physical education system for students.

Keywords: *psychophysical potential, modern physical education, students, university, assessment.*

Introduction. Currently, physical education for university students is primarily focused on developing physical fitness and maintaining physical activity, which serves as the basis for grading this course. This approach to physical education motivates students only to earn a passing grade, and upon completing their university studies, young people practically cease to engage in physical activity on a regular basis. This does not contribute to increasing the percentage of the population actively engaged in physical activity and sports. At the same time, the President of the Russian Federation and the Government have set the goal (Decree of the President of the Russian Federation No. 474 of July 21, 2020, "On the National Development Goals

of the Russian Federation for the Period up to 2030," Strategic Documents in the Field of Innovative Development) that up to 80% of the population should be regularly engaged in physical education and sports by 2030. Changing the strategy for physical education among students, specifically by improving the targeted content of the academic discipline 'Physical Education and Sports' based on the design of a comprehensive approach focused on developing students' psychophysical potential, allows for expanding the impact of physical education on the overall health of future young professionals for the country's economy [6].

The justification and development of the content of psychophysical monitoring in modern physical edu-



cation for students, along with its implementation in practice, will allow for a broader focus of this process, significantly motivate young people to engage in systematic physical education and sports, foster general physical fitness, and sustain this culture in their future professional and social activities.

Objective of the study is to justify and develop the content of psychophysical monitoring in physical education for university students as an innovative approach to the comprehensive management of the physical condition of today's student population in an educational setting, and to recommend its implementation in practice.

Methods and structure of the study. The study was conducted at Siberian Federal University in Krasnoyarsk. The sample size consisted of more than 1,200 first- through third-year students. Over the course of three years, psychophysical testing of students was conducted in the following areas: morphofunctional, psychological, cultural-educational, physical development, stress resistance, and physical education literacy. In total, more than 19 indicators were analyzed, including various indices and scales of students' psychophysical condition. The collected data was subjected to mathematical processing by psychophysical condition categories, systematized into tabular form, and levels of psychophysical readiness by category were developed, along with an integrated indicator of the psychophysical readiness of university students.

Results of the study and discussion. By 'students' psychophysical potential' (SPP), we mean a specialized educational process aimed at developing the morphofunctional, psychological, and cultural-educational (including physical education) state of students within the university's educational environment. All of this collectively contributes to the expansion of the human body's motor and physiological capabilities for subsequent safe daily functioning. The academic discipline in which the formation and development of students' psychophysical potential takes place is 'Physical Education and Sports.' Schematically, SPP can be represented as a structural model consisting of broad groups that determine their current status (Figure).

Some indicators of human physiological function have empirically established levels that range from ideal to extremely negative values, with each 'level' always corresponding to statistical data [8]. Therefore, when developing the SPP criteria (Table), we relied on the norms established by the Institute of Biomedical Problems of the Russian Academy of Sciences, Professor Vladimir Alexandrovich Orlov (research on the 'Index of Human Psychophysical Potential' is conducted under his leadership). We also took into account the "norms" developed for students by Professor Olga Nikiforovna Moskovchenko [1, 7], indicators of psychophysical potential validated in the authors' own studies [3, 4, 5], well-known tests, indices, and psychological methods by O.S. Kopina, and A.I. Pustozarov. Testing was

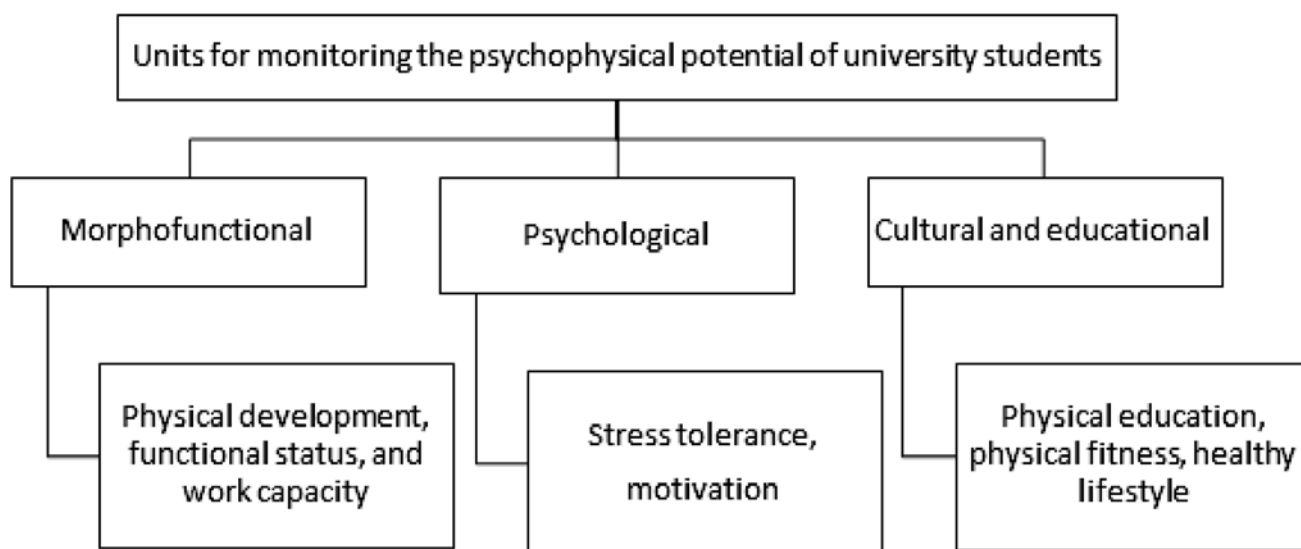


Figure. Structural components of monitoring the psychophysical potential of university students



Table. Content and Criteria for Comprehensive Psychophysical Assessment of University Students

Indicators	Grade/Score	Excellent	Good	Satisf.	Unsatisf.	Low
		5	4	3	2	1
1	Body Mass Index, kg/m ²	20,0-24,9	25,0	25,1-29,9	30,0-34,9	35,0-39,9
			19,9-18,5	18,49-17,0	16,9-16	<16
2	Pigne Index	<10	10-20	21-25	26-35	>36
3	Resting HR, bpm	<59	59-67	68-76	77-93	>93
4	Systolic blood pressure, mmHg	115-120	110-125	105-130	100-135	<95- >140
5	Vital index, ml/kg	>65	65-63	62-56	55-51	<50
6	Stange test, s	>69	69-56	55-46	45-36	<35
7	Robinson Index	<70	70-84	85-94	95-110	>110
8	Adaptive potential	1	2	2,1-3,20	3,21-4,30	>4,31
9	Ruffier Index	<0	0-5	6-10	11-15	>15
10	Hand Index	70-55	54-50	49-40	39-31	<30
11	Spinal flexibility, cm	>9	9-7	6-4	3-1	<1
12	Visual-motor reaction, cm	<15	15-18	19-22	23-27	>27
13	Anxiety	20-29	30-34	35-50	51-55	>55
14	Stress	20-25	26-30	31-45	46-70	>70
15	Psycho-emotional overload	<19-29	30-39	40-49	50-59	>60
16	Neuropsychological resources	0	<30	31-50	51-75	76-90
17	Healthy lifestyle	75	74-60	59-44	43-28	<27
18	Level of physical fitness	> 94	93-69	68-31	30-7	<6
19	Physical education	25	24-22	21-19	18-16	<16

conducted using the Spielberger-Hanin methodology: Test 1 – the State-Trait Anxiety Inventory; Test 2 – the Situational Anxiety Scale, which measures the degree of anxiety a person experiences in a specific situation. The Personal Anxiety Self-Assessment Scale consisted of 20 statement-type questions, and for each question, there were four response options based on intensity ('never' / 'almost never' / 'often' / 'almost always'). The final score for each subscale can range from 20 to 80 points [2]. The author's 'Healthy Lifestyle' questionnaire with direct and level scales.

The students' morphofunctional capabilities (SMC) were assessed based on a set of 12 indicators (Nos. 1-12). Psychological (SPC) – based on 5 indicators (Nos. 12-16). Cultural and educational (SCEC) – based on 5 indicators (Nos. 9, 10, 17, 18, 19).

Note that indicator No. 18 can be used to determine the overall level of physical fitness and the manifestation of physical qualities such as strength, endurance, agility, speed, and speed-strength (a percentile scale is used). In this case, there will be more motor indicators.

To assess students' psychophysical condition (SPC), all scores obtained in each of the aggregated

groups must be summed as the average of the three indices calculated for it: (SMC + SPC + SCEC):3 = SPC.

The resulting indicator will be a rough approximation; it is necessary to take into account gender, age, "weighting coefficients," and other characteristics. This will be reflected in the algorithm for calculating the SPP index.

For example, indicator No. 17 determines the level of development of a healthy lifestyle based on the 15-factor questionnaire we developed, using a direct scoring scale: A – 1; B – 2; C – 3; D – 4; E – 5. The maximum score is 75. Scale of healthy lifestyle development levels: very high (VH) or actively positive, creative – 75 points; high (H) or potential, passively positive – 74-60 points; moderate (M) or nominal, indifferent – 59-44 points; low (L) or pre-nominal, passively negative – 43-28 points; very low (VL) or actively negative – less than 27 points.

Indicator No. 13, which is part of a broader group of indicators of psychological capabilities, determines the level of anxiety and methods for alleviating this condition. Analysis of the results obtained during the study of the level of anxiety (SPC) allowed for the



ranking of factors causing anxiety: 1 – family problems were noted by 422 students (22.13%); 2 – financial situation – 390 students (20.45%); 3 – a large volume of course material – 343 students (17.99%); 4 – insufficient practical training – 217 students (11.38%); 5 – the global political situation – 175 students (9.18%); 6 – difficulties communicating with instructors – 150 students (7.87%); 7 – difficulties within the group or communicating with peers – 97 students (5.09%); 8 – 113 students (5.93%) selected 'other.' An analysis of the methods students use to relieve anxiety, based on their levels of anxiety (moderate, low, and high), allowed for the following ranking: 1st place – music, 2nd – sleep, 3rd – walks, 4th – the internet, 5th – food, 6 – movies, 7 – laughter, 8 – sports, 9 – video games, 10 – books, 11 – drawing and other creative hobbies, 12 – travel, 13 – meditation, 14 – other options.

Conclusions. The statistical data collected over a three-year period on 19 indicators for assessing and monitoring students' psychophysical condition made it possible to select and develop appropriate assessment categories for the psychophysical potential of today's student population. All of this, taken together, made it possible to develop levels of psychophysical potential (excellent, good, satisfactory, unsatisfactory, and low) in points across the following assessment blocks: morphofunctional, psychological, cultural-educational, physical development, stress resistance, and physical education literacy. A comprehensive indicator for assessing the psychophysical potential of university students was also developed. Such an innovative and comprehensive approach to evaluating the results of physical education for university students contributes to the expansion and modernization of the curricular and target content of the general physical education system for students.

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Theoretical and methodological prerequisites for improving the system of physical culture and sports events for persons with disabilities in a pedagogical university

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Abstract

Objective of the study **is to substantiate the necessity of improving the system of physical culture and sports events for students with disabilities in a pedagogical university and to empirically prove the effectiveness of the proposed recommendations.**

Methods and structure of the study. **A special questionnaire was developed for the study. The survey involved 300 students of the Herzen State Pedagogical University of Russia from the 1st to the 4th year, across all areas of training, assigned by medical examination results to special medical group "B" (SMG-B) with exemption from practical classes in the hall (therapeutic exercise or theoretical classes), male and female (45/55), aged 18–24 years. The students were divided into an experimental (EG) and a control (CG) group of 150 persons in each sample.**

Results and conclusions. **The results of the empirical study demonstrated that the introduction of physical culture and sports events for students with disabilities in a pedagogical university nearly doubles their involvement in physical education and sport. In connection with the proof of the effectiveness of the proposed measures, their practical application is recommended for all students with psychophysical developmental features.**

Keywords: *student, development, inclusion, university, sport.*

Introduction. The prerequisites for improving the system of physical culture and sports events for students with disabilities represent a complex of fundamental ideas, approaches and principles on which the implementation of effective physical culture and sports activities of the university is based. Understanding these prerequisites is the key to creating an inclusive environment that promotes the harmonious development of all students, regardless of their physical and psycho-emotional characteristics. Of primary importance are humanistic and learner-centred prerequisites. In the context of physical culture and sports activities, this means that events should not be merely standardised classes, but oriented towards the individual needs of students with disabilities [3].

In particular, S.O. Nikitin notes that "the possibility of students with disabilities receiving quality and accessible education at universities is the most important condition for the integration of disabled persons into society" [4, p. 407].

A.V. Starostina draws attention to the low level of sports activity among students with disabilities, in connection with which she speaks of such a prerequisite as "the necessity of introducing new, modern forms of rehabilitation and social adaptation of persons with disabilities into the educational process" [5, p. 160].

I.A. Mishchenko considers that the prerequisite for increasing the effectiveness of the physical development process of students with disabilities is "the variability of the functioning of physiological systems" [2, p. 32].

A.S. Shabalina speaks of "the insufficiency of developed methodologies adapted to the diverse nosological forms of health impairments of university students" [6, p. 624].

From the viewpoint of V.V. Shklyayev, in recent years prerequisites related to the necessity of "developing special methodologies of applied physical education that positively influence the expansion of the range of adaptive capabilities of the bodies of students with disabilities" have become relevant [7, p. 229].

D.V. Viktorov notes that "special methodologies of professionally applied physical preparation contribute to the formation of professional adaptation of students with disabilities" [1, p. 202].

The study of scientific works allows us to state the fact that the theoretical and methodological prerequisites for the development of the system of physical culture and sports events for students with disabilities in a pedagogical university include humanistic, learner-centred, systemic, adaptive, scientific, inclusive and technological conditions.

Objective of the study is to substantiate the necessity of improving the system of physical culture and sports events for students with disabilities in a pedagogical university and to empirically prove the effectiveness of the proposed recommendations.

Methods and structure of the study. The work employed theoretical (literature review, deduction, induction), practical (calculation, comparison) and empirical (questionnaire survey) methods. A special questionnaire was developed for the study. The survey involved 300 students of the Herzen State Pedagogical University of Russia from the 1st to the 4th year, across all areas of training, assigned by medical examination results to special medical group "B" (SMG-B) with exemption from practical classes in the hall (therapeutic exercise or theoretical classes), male and female (45/55), aged 18–24 years. The students were divided into an experimental (EG) and a control (CG) group of 150 persons in each sample.

Results of the study and discussion. As one of the prerequisites for improving the system of physical culture and sports events for students with disabilities at the university, it should be noted that 25.33% of respondents stated the importance of physical education as an integral part of their life, a source of health and well-being (Figure 1).

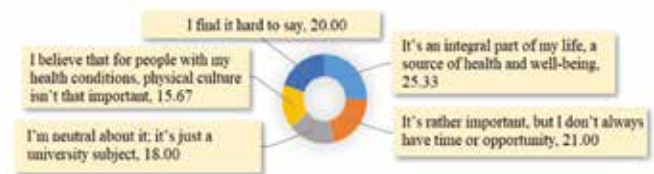


Figure 1. Results of the response to the question about how students with disabilities assess the role of physical education in their life, %

The next prerequisite is the presence of students who are dissatisfied with the conditions for physical education classes at the university (20.67%) (Figure 2).

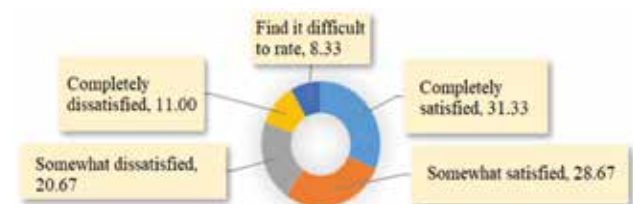


Figure 2. Results of the response to the question about whether students with disabilities are satisfied with the conditions for physical education classes at the university (availability of ramps, handrails, etc.), %

Students with disabilities would most like to engage in therapeutic physical education under the supervision of a doctor/instructor (58.67%) (Figure 3).

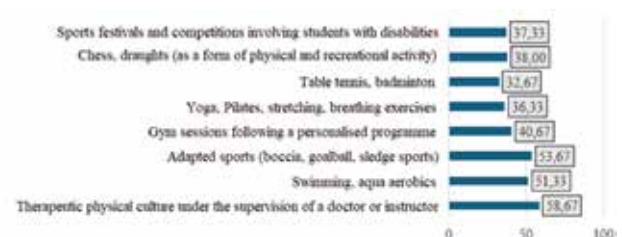


Figure 3. Results of the response to the question about what types of motor activity students with disabilities would like to see in the university schedule, %

Next, students were asked to assess their level of involvement in physical education on a 5-point scale, where 1 point corresponds to a complete absence of love for sport, and 5 points indicate regular sports practice. Mean scores made it possible to establish involvement levels (low (1–2.33 points), medium (2.34–3.66 points) and high (3.67–5 points)). The



Table 1. Dynamics of changes in involvement of students with disabilities in physical education classes

Level	EG Before (persons)	EG Before (%)	CG Before (persons)	CG Before (%)	EG After (persons)	EG After (%)	CG After (persons)	CG After (%)
Low	37	24.67	33	22.00	14	9.33	34	22.67
Medium	61	40.67	64	42.67	54	36.00	66	44.00
High	52	34.67	53	35.33	82	54.67	50	33.33
Total	150	100	150	100	150	100	150	100

Table 2. Statistical significance of differences in the level of involvement of students with disabilities in physical education classes by Student's t-test

Indicators	EG M ₁	EG $\pm m_1$	CG M ₂	CG $\pm m_2$	tp	df	p	Conclusion
Involvement at base-line, points	3.09	0.10	3.01	0.10	0.530	298	p<0.05	differences not significant
Involvement at control stage, points	3.79	0.09	3.03	0.10	5.731	298	p>0.05	differences significant

survey results showed that in both the EG and CG, students with a medium level of involvement predominate (40.67% in the EG and 42.67% in the CG).

Based on the preferences of students with disabilities, a set of physical culture and sports events was introduced for the EG: individual training sessions in an adaptive gym (strengthening specific muscle groups, posture correction); weekly yoga and Pilates classes combining static stretching exercises, strengthening of deep muscles, flexibility development and mastering relaxation techniques; holding master classes and friendly meetings in adapted sports with subsequent analysis of game moments and the opportunity to participate in university sports festivals, where students with disabilities demonstrated their achievements.

As a result of the implemented events, the EG gained 30 more persons or 57.69% more students with a high level of involvement in sport (Table 1).

The statistical significance of differences in the level of involvement of students with disabilities in physical education classes is confirmed by the calculation of Student's t-test (Table 2).

Conclusions. Thus, the physical culture and sports events implemented in practice had a pronounced positive influence on the involvement of students with disabilities in physical education classes at the pedagogical university. The positive effect was achieved thanks to the fact that each event was designed taking into account the specific needs and preferences of this category of students, which, in turn, is based on a number of key theoretical and methodological prerequisites.

Humanistic and learner-centred prerequisites made it possible to make each event maximally valuable for students. In adaptive gym training, the emphasis was placed on an individual approach under specialist supervision, which gave students a sense of care and safety, and increased their confidence in their own abilities. Within the framework of yoga and Pilates classes, a format was offered focusing on internal well-being and self-improvement, which helped many students with disabilities improve their psycho-emotional state. Events in adapted sports developed in students a sense of belonging to a team with the acquisition of positive experience from interaction with others, which is important for their social adaptation.

Systemic prerequisites manifested in the fact that the implemented events are not isolated, but act as elements of a unified system of physical culture and sports activity of the university, covering various directions (from rehabilitative and health-improving to competitive and recreational). Such a comprehensive approach makes it possible to satisfy the diverse interests of students, providing them with the opportunity to choose the type of activity most suitable for them, which, in turn, contributes to increasing overall involvement.

The principles of adaptive physical education, sociocultural and inclusive prerequisites became the foundation for creating a positive experience. The events not only developed physical activity but also provided students with disabilities with the opportunity to feel themselves as full-fledged participants of student life. The success of the implemented meas-



ures forms a positive dynamic and strengthens the desire of students with psychophysical health features to continue engaging in physical education, which is the ultimate goal of the sports programme of the pedagogical university.

Consequently, the theoretical and methodological prerequisites ensured the creation of events that not only take into account limitations, but also maximally reveal the capabilities of students with disabilities, making physical culture and sports activity an attractive and meaningful part of their life at the pedagogical university.

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Features of muscle function under load in individuals with flat feet

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Abstract

Objective of the study is to examine the features of the function of lower extremity muscles and back muscles in flatfoot using EMG.

Methods and structure of the study. The study was conducted in the laboratory of the Department of Physiology at the North-Western State Medical University named after I.I. Mechnikov, with 20 students aged 18–20 participating. The participants were divided into Group A and Group B, each consisting of 10 people. In Group A, the students had flat feet, while Group B consisted of students without flat feet. To assess muscle function, the Biopac Student Lab system was used to record muscle EMG, consisting of hardware (MP36/35/30 data acquisition unit, electrodes), BSL software (including PRO) and a laboratory manual. It is used to record and analyse muscle electrical activity during movement. The data, obtained from electrodes attached parallel to the muscle fibres, were recorded as a graph on a computer.

Results and conclusions. The data obtained from the study showed that in the presence of flatfoot, the muscles of the posterior thigh, the gastrocnemius and the longissimus muscle are subjected to the greatest additional load during physical exertion. This finding highlights the importance of organising treatment and selecting appropriate methods and means for flatfoot prevention. Prevention of flatfoot is significantly more effective and accessible than its treatment. To strengthen the muscles and the joint-ligamentous apparatus of the feet, it is recommended to perform special exercises.

Keywords: flatfoot, load, EMG (electromyogram), electrodes, muscle activity, shock-absorbing functions.

Introduction. Flatfoot is one of the most common diseases in the world. According to data from the Russian Federal Health Service and Pirogov Russian National Research Medical University, 40% to 60% of the Russian population suffers from this condition. This pathology occurs 4 times more frequently in women than in men. By age 20, signs of flatfoot are observed in 60% of citizens, and among children by age 12 – in 50% [3, 6, 10]. Flatfoot is a deformation of the foot characterised by a decrease in the height of the longitudinal arches, combined with pronation of the heel and a supination contracture of the distal part of the foot. The main symptoms are increased leg fatigue during walking, X-shaped deformation of the lower extremities, intervertebral disc impingement, decreased working capacity, etc. With improper functioning of the transverse arch of the foot, due to insufficient strength of the muscles attached to the metatarsal bones, de-

formational changes in the body occur. First and foremost, the load on the muscles of the lower extremity increases substantially. This can lead to a number of unpleasant symptoms: numbness of the feet, discomfort during walking, pain in the calf muscles and unpleasant sensations in the lumbar spine [1, 3, 6, 7, 10]. To select effective treatment, an orthopaedic doctor must clearly distinguish the types of flatfoot and understand the biomechanics of the foot.

Objective of the study is to examine the features of the function of lower extremity muscles and back muscles in flatfoot using EMG.

Methods and structure of the study. The comparative analysis involved students from the North-Western State Medical University named after I.I. Mechnikov: Group A and Group B, 10 persons each. The average height of students in the group was 165–170 cm, age – from 18 to 20 years.



Group A included students with foot arch dysfunction, while Group B consisted of students without foot pathology.

Muscle fibre activity was recorded by surface electrodes in the form of an electrical signal, which was graphically displayed on a computer. Measurements were recorded using EMG on Biopac Student Lab, consisting of hardware (MP36/35/30 data acquisition unit, electrodes), BSL software (including PRO) and a laboratory manual. The mean amplitude and frequency of EMG oscillations in both groups (mV) were analysed [2, 5, 8, 9, 11, 12]. The significance of differences of independent values was determined using Student's t-test.

EMG electrodes were placed parallel to the muscle fibres of: the gastrocnemius muscle, the muscles of the posterior thigh, the vastus medialis muscle, the lumbar multifidus muscle, and the longissimus muscle.

Electrode placement for determining muscle activity:

1. Electrodes for the gastrocnemius muscle (m. gastrocnemius) were placed in the centre of the medial belly of the muscle at a distance of 1/3 from the popliteal fossa to the calcaneal tuberosity [8].

2. The posterior thigh muscles (hamstring group) include: m. biceps femoris, m. semitendinosus, m. semimembranosus. They occupy the posterior surface of the thigh between the gluteal fold and the popliteal fossa. Electrodes were placed at the midpoint of the line connecting: the ischial tuberosity (tuber ischiadicum) and the popliteal fossa [8].

3. The vastus medialis muscle (m. vastus medialis) is located on the inner side of the thigh, in the region of the patella. Electrodes were placed 2–4 cm above and medial to the upper edge of the patella in the direction of the anterior superior iliac spine, at an angle of approximately 50–60° to the longitudinal axis of the thigh [8].

4. For the lumbar multifidus muscle (m. multifidus), electrodes were placed 2–3 cm lateral to the spinous processes at the level of the lumbosacral junction (L5–S1) along the spine (vertically) [6, 8].

5. The longissimus muscle (m. longissimus) is part of the erector spinae muscle group. Electrodes were attached along the spine approximately 3–5 cm lateral to the spinous process of the lumbar vertebra L1 in the area of the muscle ridge (muscle mass along the spine) [8].

During the study, a load in the form of walking on the spot was applied for 30 seconds at an intensity of 120 beats/second.

Results of the study and discussion. Analysis of the functional state data of the participants' muscles made it possible to identify the mean values of the maximum positive peak reflex magnitude (Table 1).

As a result of the conducted statistical analysis, differences in mean muscle tension indicators between participants were established.

The difference in gastrocnemius muscle tension indicators was 0.25 mV higher in students with flat-foot, posterior thigh muscles – by 0.8 mV, longissimus muscle – by 0.45 mV compared with healthy students. The difference is significant according to Student's t-test $p < 0.05$.

It was revealed that there are no statistically significant differences between the groups in the tension indicators of the vastus medialis muscle and the lumbar multifidus muscle.

From the obtained data, it follows that in flatfoot, additional load falls on the posterior thigh muscles, the gastrocnemius and the longissimus muscle. The obtained results are due to the fact that the indicated muscles are actively involved in running, walking and jumping.

The gastrocnemius muscle together with the soleus muscle attach to the heel through the Achilles tendon, forming the posterior calf muscle – the triceps

Table 1. Mean values of EMG oscillation amplitude

No.	Muscles	Group A (n=10)	Group B (n=10)	p
1	Gastrocnemius muscle	0.68 ± 0.012	0.43 ± 0.0013	$<0.05^*$
2	Posterior thigh muscles	0.94 ± 0.016	0.14 ± 0.001	$<0.05^*$
3	Vastus medialis muscle	0.66 ± 0.044	0.71 ± 0.033	>0.05
4	Lumbar multifidus muscle	0.45 ± 0.023	0.51 ± 0.028	>0.05
5	Longissimus muscle	0.80 ± 0.025	0.35 ± 0.005	$<0.05^*$

Note: * – statistically significant differences, Student's t-test



surae. It is involved in plantar flexion of the foot and heel elevation, as well as in extension of the lower leg and thigh backward when the foot is fixed.

The posterior thigh muscle group includes the biceps femoris, semitendinosus and semimembranosus muscles. Their participation in flexion of the lower leg at the knee joint and extension of the thigh backward ensures the performance of basic locomotor functions: walking, running, squatting and jumping.

The longissimus dorsi muscle is a powerful extensor of the vertebral column, holding the trunk in an upright position. In addition, it plays a significant role in maintaining correct posture and stabilisation of the vertebral column.

Conclusions. To minimise the risk of overloading the ligamentous-muscular apparatus in individuals with foot arch deformation who practise regular physical exercise, stretching, strengthening and overstrain prevention exercises should be included in the training process.

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Features of the psychophysiological development of younger schoolchildren with hearing impairments in the framework of the pedagogical model of physical education using swimming and tempering equipment

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Abstract

Objective of the study is to determine the psychophysiological indicators in children aged 8–10 years with varying degrees of auditory deprivation.

Methods and structure of the study. The observation was organised at a special (correctional) boarding school and the laboratory of the Department of Anatomy and Sports Medicine at the Kuban State University of Physical Culture, Sport and Tourism. The study included 29 pupils aged 8–10 years with varying degrees of auditory deprivation, engaged in the implementation of a pedagogical model of physical education using swimming and tempering activities, comprising 17 boys and 12 girls. The hardware-software computer complex "NS-PsychoTest" was used as the research instrument. The following indicators were assessed in the subjects: simple visual-motor reaction (SVMR), reaction to a moving object (RMO), "discrimination reaction" (DR), and "choice reaction" (CR).

Results and conclusions. The simple visual-motor reaction indicators obtained during the study may be determined by anatomical features of the analyser, properties of nervous processes, the psychophysiological state of the body and the motor-coordination potential of the subject. As children mature, the sensorimotor reaction period decreases, which is associated with the maturation of central brain structures and the improvement of the functional state of the neuromuscular apparatus. In children aged 9–10 years, the degree of balance between excitation and inhibition processes in terms of strength is greater. This indicates a greater equilibrium of nervous processes and stability of nervous system functioning at this age. As children mature, the number of delayed and anticipatory reactions decreases significantly, which is due to the intensive development of central mechanisms.

Keywords: *children aged 8–10 years, auditory deprivation, psychophysiological indicators, correctional boarding school, beginning of the academic year.*

Introduction. The study was conducted with the financial support of the Kuban Scientific Foundation within the framework of the research project No. PPP-24.1/20 "A pedagogical model of physical education for children of the second childhood period with varying degrees of auditory deprivation based on swimming and tempering activities".

In the system of modern school physical education, priority is given to strengthening the health of pupils, developing physical qualities, forming motor skills and increasing the level of motor fitness. These directions

retain their primary significance and determine the content of most physical culture programmes. At the same time, the possibilities of physical education in solving tasks related to the psychophysiological development of the child are not fully utilised. In primary school practice, tasks of targeted influence on attention, sensorimotor functions, voluntary regulation of actions and other psychophysiological characteristics of younger schoolchildren are not set frequently enough [1, 2, 6].

This problem is of particular significance in children with auditory deprivation aged 8–10 years. At this



stage of ontogenesis, the functional formation of the central nervous system and sensory systems continues, the mechanisms of sensory information processing are refined, the foundations of voluntary control are formed, and the coordination of motor reactions increases. The functional capabilities of the child's body have not yet reached full maturity; however, it is precisely during this age period that pedagogical influence is distinguished by high effectiveness. For this reason, physical education should be considered not only as a means of developing the motor sphere, but also as an important factor in the formation of psychophysiological characteristics [2, 5].

In assessing the effectiveness of a pedagogical model of physical education, psychophysiological characteristics occupy a significant place. They reflect the features of central nervous system functioning, the state of sensory systems, the speed and accuracy of motor responses, as well as attention parameters that are directly related to the educational activity of children aged 8–10 years. Analysis of such characteristics makes it possible to identify not only the result of motor training, but also deeper changes associated with the child's adaptation to educational and physical loads. Therein lies their high informational value for the pedagogy of physical education [1, 7].

In this connection, there arises the need for a special study of the psychophysiological characteristics of younger schoolchildren engaged in the implementation of a pedagogical model of physical education using swimming and tempering activities. Such a study makes it possible to clarify the pedagogical possibilities of this model, to establish its influence on the psychophysiological state of pupils, and to supplement ideas about the content of physical education in primary school, taking into account the age-related features of child development.

Objective of the study is to determine the psychophysiological indicators in children aged 8–10 years with varying degrees of auditory deprivation.

Methods and structure of the study. The scientific work was conducted at a special (correctional) boarding school in Krasnodar, as well as in the laboratory of the Department of Anatomy and Sports Medicine at the Kuban State University of Physical Culture, Sport and Tourism. Twenty-nine pupils participated in the observation, including 17 boys and 12 girls.

The factual material was obtained using the hardware-software computer complex "NS-PsychoTest" produced by the company "Neuro Soft" (Ivanovo).

The simple visual-motor reaction (SVMR) was determined in the subjects. This indicator was used for testing speed and quickness of response.

In addition, the reaction to a moving object (RMO) was studied, which is a type of complex sensorimotor reaction, since in addition to the sensory and motor periods it includes a stage of relatively complex processing of the sensory signal by the central nervous system (CNS).

According to I.N. Mantrova (2008), the predominance of anticipatory reactions with a proportion of delayed reactions of less than 10.0% indicates the predominance of excitation in the activity of nerve centres; a difference between the number of anticipatory and delayed reactions of no more than 10.0% indicates the equilibrium of nervous processes; the predominance of delayed reactions with a proportion of anticipatory reactions of less than 10.0% reflects the predominance of inhibitory processes in the activity of the CNS [4].

In studying the psychophysiological indicators of children aged 8–10 years, the "discrimination reaction" (DR) and "choice reaction" (CR) methods were additionally employed. A number of researchers classify discrimination reaction time as complex sensorimotor reactions and use it to assess the mobility of nervous processes in the CNS [4].

An individual protocol was completed for each subject. All children participated voluntarily. Written informed consent was obtained from parents and their legal representatives. Processing of experimental data was performed using standard mathematical-statistical methods on IBM-compatible computers [3].

Results of the study and discussion. Analysis of the obtained SVMR data (Table 1) established that boys aged 8 years showed higher reaction time values compared with schoolchildren aged 9 and 10 years ($p_{1-2} < 0.05$; $p_{1-3} < 0.05$). The highest speed during testing was demonstrated by pupils aged 9–10 years. However, no significant differences between the obtained parameters in these groups were recorded ($p_{2-3} > 0.05$).

Analysis of the obtained SVMR results in girls showed a similar pattern (Table 2). Thus, the slowest response to the light stimulus was shown by schoolgirls aged 8 years compared with 9-year-olds and 10-year-olds ($p_{1-2} < 0.05$; $p_{1-3} < 0.01$), while no differences in parameters between 9- and 10-year-old girls were recorded ($p_{2-3} > 0.05$).

In the study of RMO, it was established (Table 1) that the reaction time in boys aged 8 years was high-



Table 1. Simple visual-motor reaction time (SVMR) and reaction to a moving object (RMO) in boys aged 8–10 years at the beginning of the academic year ($M \pm m$)

Indicators	Unit of measurement	8 years (n=6)	9 years (n=6)	10 years (n=5)
SVMR	ms	296.1±8.5	268.4±7.4	259.5±9.2
			$p_{1-2} < 0.05$ $r=2.44$	$p_{1-3} < 0.05$ $r=2.91$
				$p_{2-3} > 0.05$ $r=0.75$
RMO	ms	82.6±3.0	72.1±2.7	60.8±2.6
			$p_{1-2} < 0.05$ $r=2.60$	$p_{1-3} < 0.0001$ $r=5.49$
				$p_{2-3} < 0.01$ $r=3.01$

Note: p_{1-2} – significance of differences between the indicators obtained in the "SVMR" and "RMO" tests in boys aged 8 and 9 years; p_{1-3} – significance of differences between the indicators obtained in the "SVMR" and "RMO" tests in boys aged 8 and 10 years; p_{2-3} – significance of differences between the indicators obtained in the "SVMR" and "RMO" tests in boys aged 9 and 10 years.

Table 2. Simple visual-motor reaction time (SVMR) and reaction to a moving object (RMO) in girls aged 8–10 years at the beginning of the academic year ($M \pm m$)

Indicators	Unit of measurement	8 years (n=4)	9 years (n=4)	10 years (n=4)
SVMR	ms	310.3±11.6	268.8±12.2	249.7±10.8
			$p_{1-2} < 0.05$ $r=2.51$	$p_{1-3} < 0.01$ $r=3.89$
				$p_{2-3} > 0.05$ $r=1.17$
RMO	ms	87.9±3.9	73.1±4.6	63.5±5.7
			$p_{1-2} < 0.05$ $r=2.45$	$p_{1-3} < 0.01$ $r=3.53$
				$p_{2-3} > 0.05$ $r=1.31$

Note: p_{1-2} – significance of differences between the indicators obtained in the "SVMR" and "RMO" tests in girls aged 8 and 9 years; p_{1-3} – significance of differences between the indicators obtained in the "SVMR" and "RMO" tests in girls aged 8 and 10 years; p_{2-3} – significance of differences between the indicators obtained in the "SVMR" and "RMO" tests in girls aged 9 and 10 years.

er ($p_{1-2} < 0.05$; $p_{1-3} < 0.01$) than in schoolchildren aged 9–10 years. At the same time, the parameters in schoolchildren aged 9–10 years differed ($p_{2-3} < 0.01$). That is, boys aged 10 years showed a more temporally accurate RMO, which reflects a balanced variant of nervous processes.

As the analysis of results obtained in the RMO in girls showed (Table 2), significant differences in time were found between schoolgirls aged 8, 9 and 10 years ($p_{1-2} < 0.05$; $p_{1-3} < 0.01$). In turn, no differences between the values of this parameter in girls aged 9 and 10 years were recorded.

In the process of studying complex sensorimotor reactions of discrimination and choice, the following values were recorded: the longest DR parameters were noted in boys aged 8 years, the shortest in schoolchildren aged 9 and 10 years ($p_{1-2} < 0.001$; $p_{1-3} < 0.001$). At the same time, significant differences in this test between 9-year-olds and 10-year-olds were noted ($p_{2-3} < 0.01$) (Table 3).

As regards the testing of boys in CR, the data obtained fall within the functional norm, and no differences in age parameters (8–10 years) were noted.

As the analysis showed (Table 4), in the DR test in

girls aged 10 years the shortest time was recorded in relation to 8-year-olds ($p_{1-3} < 0.01$). When comparing other age groups, no significant differences were found.

With regard to the CR results obtained in girls (8–10 years), it should be noted that there was no difference in indicators.

Conclusions. Thus, it can be concluded that in children aged 8–10 years, during the implementation of the process of motor acts that are interconnected with complex visual-motor actions, the mechanisms of cortical organisation are substantially restructured. As children mature, the sensorimotor reaction period decreases due to the "maturation" of (central) brain structures and the optimisation of the functional state of the neuromuscular apparatus.

The parameters of the complex sensorimotor reaction to a moving object showed that in children with auditory deprivation the degree of balance between excitation and inhibition processes in terms of strength is greater, which indicates the equilibrium of nervous processes and the stability of nervous system functioning at this age. The indicators identified in the "discrimination reaction" and "choice reaction" indi-



Table 3. Discrimination reaction time (DR) and choice reaction time (CR) in boys aged 8–10 years at the beginning of the academic year ($M \pm m$)

Indicators	Unit of measurement	8 years (n=6)	9 years (n=6)	10 years (n=5)
DR	ms	423.1 $\pm$ 7.3	388.4 $\pm$ 5.2	358.0 $\pm$ 9.7
			$p_{1-2} < 0.001$ $r = 3.87$	$p_{1-3} < 0.001$ $r = 5.36$
				$p_{2-3} < 0.01$ $r = 2.76$
CR	ms	454.7 $\pm$ 17.3	442.6 $\pm$ 10.2	438.5 $\pm$ 8.6
			$p_{1-2} > 0.05$ $r = 1.04$	$p_{1-3} > 0.05$ $r = 0.74$
				$p_{2-3} > 0.05$ $r = 0.44$

Note: p_{1-2} – significance of differences between the indicators obtained in the "DR" and "CR" tests in boys aged 8 and 9 years; p_{1-3} – significance of differences between the indicators obtained in the "DR" and "CR" tests in boys aged 8 and 10 years; p_{2-3} – significance of differences between the indicators obtained in the "DR" and "CR" tests in boys aged 9 and 10 years.

Table 4. Discrimination reaction time (DR) and choice reaction time (CR) in girls aged 8–10 years at the beginning of the academic year ($M \pm m$)

Indicators	Unit of measurement	8 years (n=4)	9 years (n=4)	10 years (n=4)
DR	ms	421.1 $\pm$ 10.9	391.2 $\pm$ 12.5	372.3 $\pm$ 9.4
			$p_{1-2} < 0.05$ $r = 1.80$	$p_{1-3} < 0.01$ $r = 3.39$
				$p_{2-3} > 0.05$ $r = 1.21$
CR	ms	453.3 $\pm$ 9.7	450.6 $\pm$ 10.1	449.7 $\pm$ 11.4
			$p_{1-2} > 0.05$ $r = 1.0$	$p_{1-3} > 0.05$ $r = 0.73$
				$p_{2-3} > 0.05$ $r = 0.28$

Note: p_{1-2} – significance of differences between the indicators obtained in the "DR" and "CR" tests in girls aged 8 and 9 years; p_{1-3} – significance of differences between the indicators obtained in the "DR" and "CR" tests in girls aged 8 and 10 years; p_{2-3} – significance of differences between the indicators obtained in the "DR" and "CR" tests in girls aged 9 and 10 years.

cate the mobility of nervous processes; with age, in children with auditory deprivation there is a significant decrease in the number of delayed and anticipatory reactions, due to the intensive development of central mechanisms.

The results presented in the study are characterised by theoretical and practical significance, as they are capable of participating in the formation of a procedural-technological solution applied during the implementation of the tasks of a pedagogical model of physical education using swimming and tempering activities.

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Organization of physical education classes in special medical groups under digitalization conditions

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Abstract

Objective of the study is to determine the effectiveness of special medical group classes under the conditions of digitalization of the university's physical education system.

Methods and structure of the study. The experiment involved 36 students from a special medical group, divided into experimental and control groups. Classes in the experimental group are organized on the basis of a structural-functional model integrating traditional means of Adapted Physical Culture (APC) and digital educational technologies; during the classes, digital monitoring tools for physical activity and functional state of students are used, providing objective control and individualization of motor loads; systematic pedagogical support for students with health limitations is ensured using digital feedback channels; the content of classes is adapted to the individual psychophysical capabilities of students and implemented in face-to-face, distance, and blended formats; elements of self-control and self-regulation of students' motor activity are purposefully incorporated into the educational process.

Results and conclusions. The results obtained during the experiment allow us to conclude that the introduction of digital tools into the process of organizing classes creates additional pedagogical conditions for increasing the effectiveness of the body's adaptive responses.

Keywords: *physical education, digital technologies, students of special medical group.*

Introduction. The digitalization of physical education in universities is accompanied by a number of contradictions. On the one hand, digital technologies possess significant potential in terms of individualizing motor loads, objective monitoring of physical condition, and expanding forms of students' independent work.

Modern scientific research in the field of digitalization of education and physical education demonstrates a sustained interest in the use of mobile technologies, wearable digital devices, biofeedback systems, and data analytics for assessing students' physical activity. Research results indicate that wearable fitness trackers can be an effective tool for encouraging physical activity and exercise habits among students of technical universities. Real-time feedback provided by wearable technology prompted participants to engage more in physical activity and strength exercises [2]. When

studying physical culture, it is important to consider the transition from traditional means to the direct use of information technologies. For educators, it is currently particularly important to fully integrate information technologies into the processes of physical education and sports, training, teaching, and competitions. This allows for a more effective approach to process organization, setting educational goals, and developing communication skills and knowledge [1, 3].

Objective of the study is to determine the effectiveness of special medical group classes under the conditions of digitalization of the university's physical education system.

Methods and structure of the study. The pedagogical experiment involved 1st- and 2nd-year students assigned to a special medical group based on their health status and permitted to attend physical education classes. The sample was formed based on



medical reports and the voluntary consent of students to participate in the study. A total of $N = 64$ students took part in the experiment and were divided into two statistically comparable groups: control group (CG) – 32 people; experimental group (EG) – 32 people.

In the control group, classes were conducted according to the existing work program of the discipline without the targeted use of digital educational technologies. The basis of the educational process consisted of traditional forms and methods for the special medical group: frontal and group classes, verbal instructions from the teacher, demonstration of exercises, standard exercise sets taking into account medical indications.

In the experimental group, classes were implemented based on a developed structural-functional model that предусматривает the systematic use of digital tools: electronic educational platforms, video content with adapted motor programs, digital tools for monitoring motor activity and functional state, as well as elements of distance and blended learning formats.

Results of the study and discussion. The methodological basis of the research was built on the principles of systematicity, complexity, individualization, and objectivity of control, which ensured the reliability and reproducibility of the obtained experimental data.

During the pedagogical experiment, the following groups of methods were applied: methods of theoretical analysis and synthesis of scientific-methodological literature; pedagogical methods (observation, pedagogical experiment); methods of functional diagnostics; methods for assessing motor preparedness; psychological-pedagogical methods for studying motivation and attitudes of students towards APC classes; methods of mathematical-statistical processing of research results.

The functional state of the students' organisms was one of the key indicators of the effectiveness of Adapted Physical Culture classes. The study used safe and well-proven methods recommended for work with students of special medical groups.

In the experimental group, digital tools integrated into the educational process for Adapted Physical Culture were used as means of pedagogical influence and diagnostics. These included: the university's electronic educational platform for posting educational materials and providing feedback; video content with adapted sets of physical exercises; wearable fitness trackers for monitoring motor activity and heart rate; elements of video analysis of motor actions used to correct exercise technique. The use of digital tools expanded the possibilities of ongoing and final control,

Table 1. Characteristics of the sample of experiment participants

Indicators	Control group (n=32)	Experimental group (n=32)
Average age, years	$18,9 \pm 0,6$	$19,1 \pm 0,5$
Gender (M/F), people	14 / 18	15 / 17
Musculoskeletal disorders, people	10	9
Functional diseases (CVS, respiratory system), people	12	13
Chronic somatic diseases, people	10	10
Average level of physical fitness (points)	$2,8 \pm 0,4$	$2,7 \pm 0,5$
Admission to APC classes	100%	100%

Table 2. Diagnostic methods used in the pedagogical experiment

Group of indicators	Methods and tests	Parameters diagnosed	Stages of application
Functional state	Heart rate (HR) measurement at rest and after load, Ruffier test	State of CVS, adaptation to load	Initial, final
Functional state	Vital capacity (VC)	Functional capabilities of the respiratory system	Initial, final
Motor preparedness	6-minute walk test	General endurance	All stages
Motor preparedness	Forward bend from sitting position	Spinal flexibility	All stages
Motor preparedness	Arm lift with gymnastic stick	Shoulder girdle mobility	All stages
Motivation	Student questionnaire	Educational motivation, interest in APC	Initial, final
Digital activity	Fitness tracker data	Level of motor activity, HR	Formative stage



contributed to increased visibility of educational material, and individualization of physical loads.

For processing experimental data, methods of variation statistics were used. Arithmetic means (M), standard deviation (σ), and relative changes in indicators over time were calculated. The significance of differences between the indicators of the control and experimental groups was determined using parametric criteria (Student's t -test) at a significance level of $p < 0.05$. Statistical data processing was carried out using spreadsheet software and specialized statistical packages.

The development of a structural-functional model for organizing Adapted Physical Culture classes in a digital educational environment was based on the need for a systematic rethinking of the traditional approach to implementing APC at the university. Modern conditions of digitalization of higher education require a transition from the fragmentary use of individual digital tools to an integral pedagogical system in which digital technologies act not as an auxiliary, but as a structure-forming element.

Analysis of the students' functional state showed positive dynamics of indicators in both groups, indicating the beneficial effect of regular Adapted Physical Culture classes. At the same time, the magnitude of changes in the experimental group was statistically significantly higher for a number of key parameters.

The most distinct changes were recorded in heart rate at rest, Rufier index, and vital capacity, indicating an increase in the functional capabilities of the cardiovascular and respiratory systems of students in the experimental group.

The results of the motor preparedness assessment showed that students in the experimental group exhibited more pronounced positive dynamics across all studied physical qualities. This indicates the feasibility of using digital tools for individualizing loads and increasing the effectiveness of APC classes.

Particularly significant differences between groups were identified in indicators of general endurance and flexibility, which largely depend on the regularity and awareness of exercise performance.

Analysis of the questionnaire data showed that in the experimental group there was a more pronounced increase in educational motivation and interest in APC classes. Students in the experimental group more often noted an increase in the awareness of classes, the convenience of using digital materials, and increased confidence in independent physical culture and health improvement activities.

In the control group, positive changes were less pronounced and were largely associated with the factor of class regularity.

Conclusions. Overall, the results of the pedagogical experiment indicate the higher effectiveness of the

Table 3. Dynamics of functional indicators of students in the control and experimental groups ($M \pm \sigma$)

Indicators	Group	Initial stage	Final stage	Δ , %
Resting HR, beats/min	CG	78,6 $\pm$ 4,2	75,9 $\pm$ 3,8	-3,4
	EG	79,1 $\pm$ 4,5	72,8 $\pm$ 3,6*	-7,9
Rufier index, points	CG	11,2 $\pm$ 1,3	10,4 $\pm$ 1,2	-7,1
	EG	11,4 $\pm$ 1,4	9,1 $\pm$ 1,1*	-20,2
VC, ml	CG	3120 $\pm$ 210	3240 $\pm$ 220	+3,8
	EG	3090 $\pm$ 230	3460 $\pm$ 240*	+12,0

Note: Differences are statistically significant compared to the control group at $p < 0.05$.

Table 4. Dynamics of motor preparedness indicators of students ($M \pm \sigma$)

Indicators	Group	Initial stage	Final stage	Δ , %
6-minute walk test, m	CG	512 $\pm$ 34	534 $\pm$ 36	+4,3
	EG	508 $\pm$ 32	568 $\pm$ 35*	+11,8
Forward bend, cm	CG	5,8 $\pm$ 2,1	7,1 $\pm$ 2,3	+22,4
	EG	5,6 $\pm$ 2,0	9,4 $\pm$ 2,5*	+67,9
Shoulder girdle mobility, cm	CG	9,6 $\pm$ 1,8	10,3 $\pm$ 1,9	+7,3
	EG	9,4 $\pm$ 1,7	11,8 $\pm$ 2,0*	+25,5

Note: Differences are statistically significant compared to the control group at $p < 0.05$.



Table 5. Indicators of educational motivation of students (in points, $M \pm \sigma$)

Indicators	Group	Initial stage	Final stage	Δ , %
Interest in APC classes	CG	$2,9 \pm 0,5$	$3,2 \pm 0,6$	+10,3
	EG	$2,8 \pm 0,6$	$3,8 \pm 0,5^*$	+35,7
Awareness of students during classes	CG	$2,7 \pm 0,6$	$3,0 \pm 0,5$	+11,1
	EG	$2,6 \pm 0,5$	$3,7 \pm 0,6^*$	+42,3
Readiness for independent classes	CG	$2,5 \pm 0,5$	$2,9 \pm 0,6$	+16,0
	EG	$2,4 \pm 0,6$	$3,6 \pm 0,5^*$	+50,0

Note: Differences are statistically significant compared to the control group at $p < 0.05$.

structural-functional model for organizing physical education classes in a special medical group within a digital educational environment compared to the traditional organization of the educational process:

1. The organization of Adapted Physical Culture classes in a university's digital educational environment contributes to a more pronounced improvement in the functional state of students in special medical groups compared to the traditional model of conducting classes.

2. The implementation of a structural-functional model based on the systematic use of digital tools enhances the effectiveness of adaptive responses of the cardiovascular and respiratory systems due to more precise dosing and individualization of physical load.

3. The implementation of the experimental model positively affects the level of motor preparedness of students, which is manifested in a significant increase in indicators of general endurance, flexibility, and shoulder girdle mobility.

4. A significant increase in educational motivation, interest in classes, and readiness for independent physical culture and health improvement activities among students in the experimental group confirms the importance of the digital educational environment as a factor in activating the subjective position of

learners. It ensures the integrity of pedagogical influence through the integration of target, content, technological, and resultant blocks into a single system.

5. The experimental verification of the model confirmed the proposed hypothesis regarding the feasibility of systematic implementation of digital technologies into the process of Adapted Physical Culture at the university as a condition for increasing its health-improving and pedagogical effectiveness.

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Development of student sport in agrarian universities of Russia at the present stage

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Abstract

Objective of the study is to determine the main trends in the development of student sport in agrarian universities of Russia.

Methods and structure of the study. The methodological basis of the study consisted of the analysis and synthesis of documents regulating the development of student sport in recent years. The materials of speeches by heads and representatives of ministries and departments, as well as famous athletes at events of various levels, were analysed. Announcements, news and final publications on the websites of 'Rosstudsport,' RSSS, ASSK Russia and other social networks were analysed.

Results and conclusions. The main trends in the development of student sport in agrarian universities until 2030 will be: the introduction of a mandatory set of competitions in key sports included in the AgroLeagues; the inclusion of agrarian universities in the projects of the RSSS and ASSK Russia; the creation of student sports clubs in 100% of universities; the creation of a long-term plan for the sporting life of students until 2030; partnerships with local agro-industrial complexes for participation in events outside universities, ambassadorship for organisations and enterprises; the formation of a community of agro-industrial complex and student sport leaders; the use of digital technologies for organising events in the media space and social networks; the search for sources of financing, and others. As the main mechanism for developing student sport, it is proposed to create AgroLeagues within the structure of universities and to hold the All-Russian Spartakiad 'AgroLeague' in 10 sports in several stages.

Keywords: *student sport, subjects of student sport, student sports leagues, student sports clubs, agrarian universities.*

Introduction. The decline in the number and deterioration in the health of young people has raised before the state the question of the necessity of focusing on a radical improvement in the quality of the existing youth human resource, minimising physical and social losses, maximally deep and effective socialisation of young people, and the formation of attitudes towards independence and leadership qualities in them. One of the priority directions of state policy in Russia is the involvement of youth in systematic physical culture and sport activities [3, 5, 12, 15].

In recent years, documents defining the development of physical culture and sport in Russia until 2030 have been developed. The Presidential Decree "On the National Development Goals of the

Russian Federation for the Period until 2030" emphasised the growth of the share of citizens systematically engaged in physical culture and sport to 70%. The Inter-Sectoral Programme for the Development of Student Sport until 2030 provides for an increase in the number of students engaged in physical culture and sport, an increase in the number of student sports clubs in the structure of universities, an increase in the number of universities participating in all-Russian official events, and an increase in the number of student sports leagues [7, 13]. According to a sociological survey, 70% of students want to engage in sport within the walls of universities, and 55% of students have this opportunity [2, 6, 11].



At the current stage of development of student sport, various events are actively held, regulated by federal governing bodies such as the Ministry of Science and Education, the Ministry of Sport and the Federal Agency for Youth Affairs (Rosmolodezh). The period from 2021 to 2025 is indicative, when 38 student sports leagues and 888 student sports clubs were created, and approximately 100 sports projects with the participation of university students in various regions of Russia were implemented [4, 8, 9, 10].

Along with the above-mentioned federal governing bodies, in 2025 the Ministry of Agriculture defined a concept for the development of student sport until 2030 in all agrarian universities. Agrarian universities have always occupied an active position in involving student youth in systematic sports practice, carried out extensive work in organising and conducting departmental Universiads for 20 years, resolved the tasks of preparing the country's sports reserve, had their own council on physical culture and sport under the association 'Agroobrazovanie,' had the skills of planning sports work with students for each five-year period, forming a multi-level system of physical culture and sports events for students. This mechanism of interaction between agrarian universities in differ-

ent regions of Russia created a unique opportunity for uniting the entire student community of the agrarian profile throughout Russia, enabled familiarisation with the capabilities of different universities and strengthening of friendly ties. The Universiads of the Ministry of Agriculture of Russia universities always took the form of a sports festival, creating a positive atmosphere for each student to demonstrate their capabilities.

Confirmation of the effectiveness of this model of student sport development is the number of champions, prize-winners and participants of the Olympic Games among students and graduates of agrarian universities. To date, there are 41 well-known Olympic athletes from 18 agrarian universities of Russia. Of these, 18 are Olympic champions, 7 are silver medalists and 4 are bronze medallists.

Objective of the study is to determine the main trends in the development of student sport in agrarian universities of Russia.

Methods and structure of the study. The methodological basis of the study consisted of the analysis and synthesis of documents regulating the development of student sport in recent years. The materials of speeches by heads and representatives of ministries and departments, as well as famous athletes at

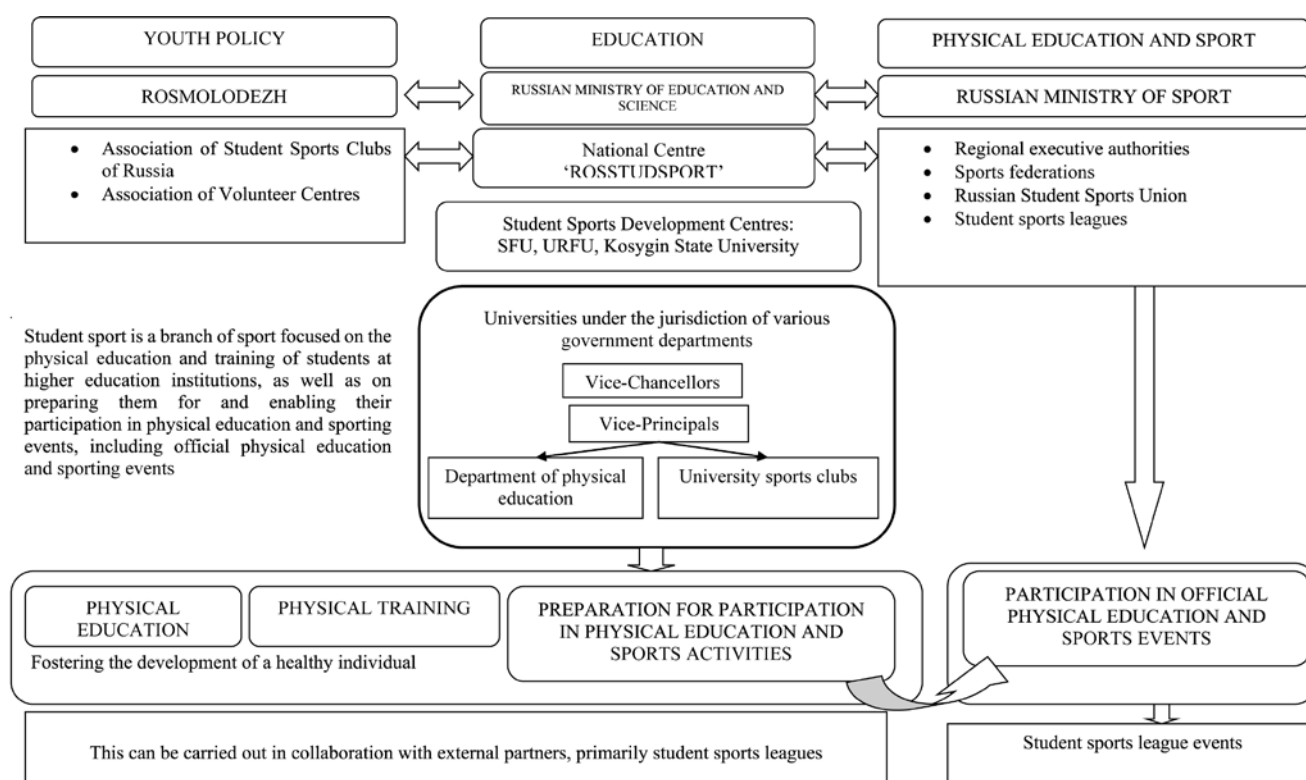


Figure 1. Modern system of student sport (Congress "ROSSTUDSPORT", 2025)



events of various levels, were analysed. Announcements, news and final publications on the website of "Rosstudsport", RSSS, ASSK Russia and other social networks were analysed. The opinions of well-known scientists who have studied the problems of student sport for many years were also examined.

Results of the study and discussion. The Ministry of Agriculture has 44 agrarian universities under its supervision, which participate in various projects in the sphere of youth policy, education and sport. Agrarian universities of Russia are actively included in all events held by the RSSS, ASSK and sports leagues.

The leading subjects of student sport coordinating the work on organising and holding various sports events at the regional level are the Russian Student

Sports Union, the Association of Student Sports Clubs of Russia, sports federations and student sports leagues in various sports [1, 14].

During the period from 2021 to 2025, the system of student sport underwent a number of changes and was presented at the Congress "ROSSTUDSPORT" in 2025 (Figure 1).

With the active position of agrarian universities on the development of student sport, the Ministry of Agriculture of the Russian Federation is carrying out a number of measures to address the tasks set by the Inter-Sectoral Programme for the Development of Student Sport until 2030.

In this connection, the Ministry of Agriculture conducted an analysis of the involvement of students of

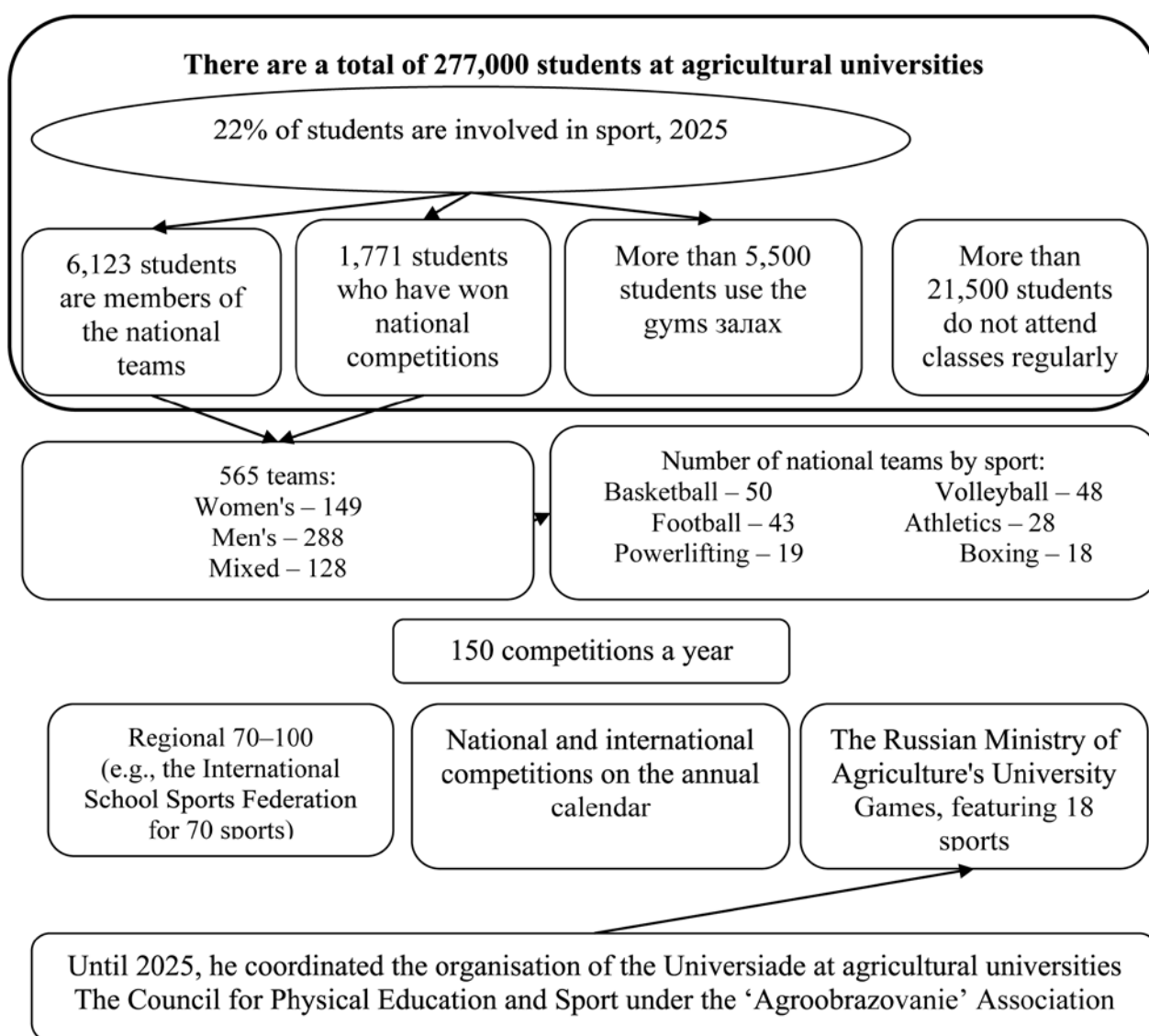


Figure 2. Analysis of sport development in agrarian universities of Russia

subordinate universities in sports practice, the results of which are presented in Figure 2.

565 representative teams: Women's – 149, Men's – 288, Mixed – 128. Total number of students in agrarian universities: 277,000. 1,771 students are winners of all-Russian competitions. 6,123 students are members of representative teams. More than 5,500 students train in gyms. More than 21,500 students train non-systematically. 22% of students are involved in sport, 2025. Number of representative teams by sport: Basketball – 50, Volleyball – 48, Football – 43, Athletics – 28, Powerlifting – 19, Boxing – 18. Until 2025, the Council on Physical Culture and Sport under the association 'Agroobrazovanie' coordinated the holding of Universiads in agrarian

universities. 150 competitions per year. Regional – 70-100 (for example, MSSI in 70 sports). All-Russian and international competitions of the annual calendar. Universiad of the Ministry of Agriculture of Russia universities in 18 sports.

According to the results of 2025, out of 277 thousand students studying at agrarian universities, only 22% were involved in sport. In this connection, the Minister of Agriculture set the task of increasing the number of agrarian university students involved in sport to 70% by 2030.

The analysis revealed that in agrarian universities, 6,123 students are members of representative teams in various sports, 1,771 students are winners at all-Russian competitions. In sports such as volleyball,

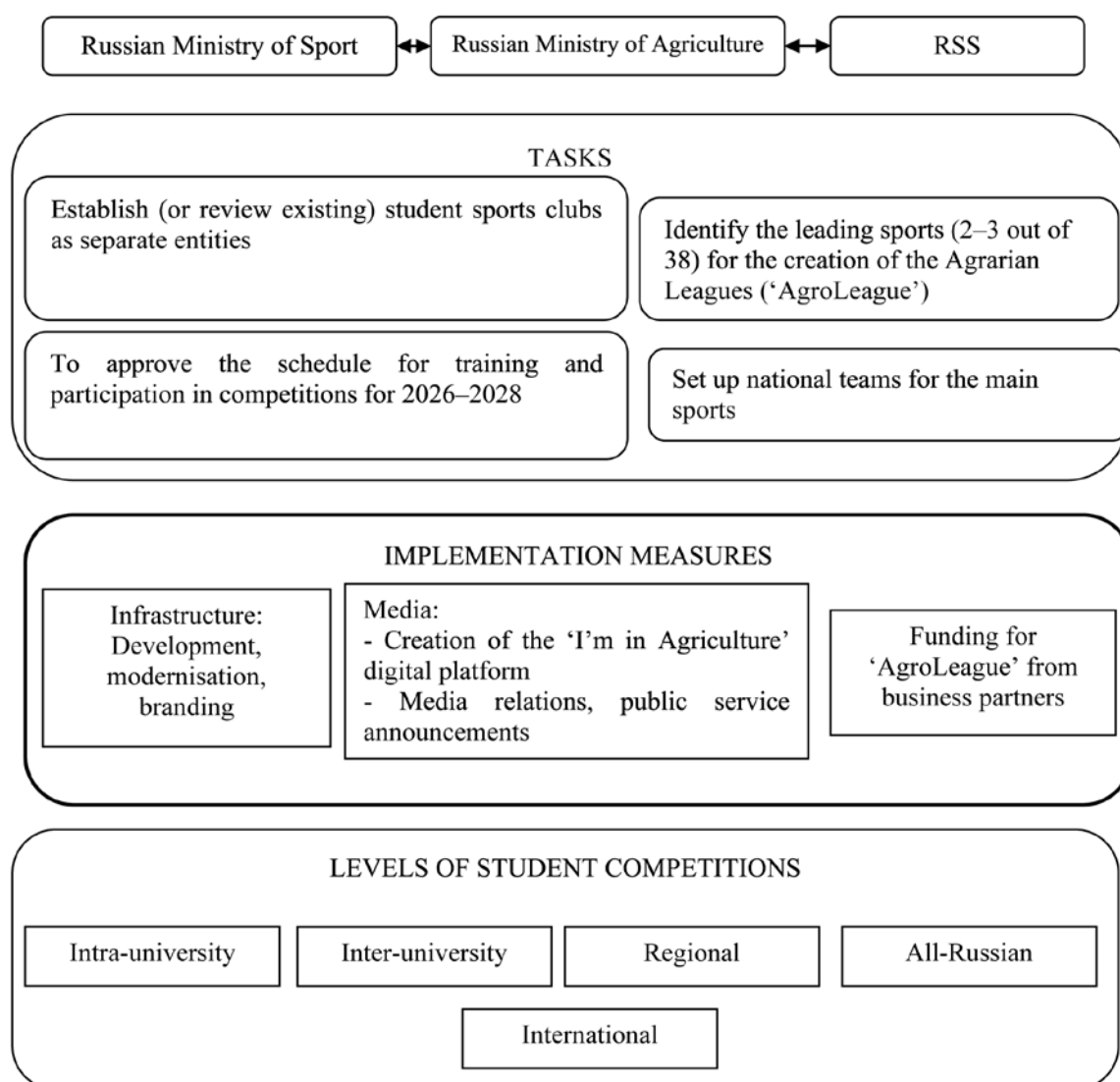


Figure 3. Concept of student sport development in agrarian universities of Russia (2025)



Table. Pathways for resolving the stated tasks of student sport development in agrarian universities of Russia

REASONS	SOLUTIONS
Share of students engaged in sport	– Introduction of a mandatory set of competitions in key sports – ‘AgroLeague’; – Inclusion of agrarian universities in RSSS and ASSK Russia projects; – Partnerships with local agro-industrial complexes: opportunity to participate in events outside universities, ambassadorship for organisations and enterprises
Absence of “live” students in student sports clubs	– Development of a student sport development strategy: creation of a long-term plan for students’ sporting life; – Creation of student sports clubs in 100% of universities; – Attraction of grants for project implementation: methodological assistance in writing, grant training
Unrealised potential of student sport as a tool for attracting applicants	– Formation of a community of agro-industrial complex and student sport leaders; – Use of digital technologies: platforms for organising events, social networks, applications; – Ministry leadership in student sport development; – Development of the programme “Agrosport is cool!”

basketball, football, athletics, powerlifting and boxing, 565 representative teams have been created.

Annually, students of agrarian universities participate in more than 150 competitions. For example, approximately 60 student-athletes of the main agrarian university are members of the Moscow representative team and more than 12 student-athletes are members of the Russian representative team, who annually participate in 70-100 competitions at the regional level and 10-20 competitions at the international level.

Based on the analysis conducted, the Ministry of Agriculture of the Russian Federation defined a concept for the development of student sport until 2030 in subordinate universities in accordance with the Inter-Sectoral Programme. The concept defines priority tasks, unified coordination of activities by the Ministry of Agriculture, and means of implementation (Figure 3).

First of all, the Ministry of Agriculture defined key approaches to the development of student sport within agrarian universities. To date, 50 popular sports out of 157 in the All-Russian Register of Sports are developed in agrarian universities. The RSSS together with Federations has created 38 leagues by sport, while the Ministry of Agriculture sets the task of creating ‘AgroLeagues’ in 2–3 sports. The Ministry of Agriculture has also defined only 20 sports for active development at this stage. Furthermore, out of 44 agrarian universities, student sports clubs as separate structural subdivisions have been created in only 27, which constitutes 61.4% (target – 100%). In connection with the data presented, efforts should primarily be directed towards resolving a number of tasks, such

as increasing the number of students systematically engaged in sport, developing basic sports in the region, establishing and strengthening ties with the agro-industrial complex through promoting healthy lifestyle values among students – future specialists in the agrarian sphere, and strengthening the image of agrarian universities. The Table presents pathways for resolving the stated tasks of student sport development in agrarian universities.

As the main mechanism for the development of student sport, it is proposed to create AgroLeagues within the structure of universities and to hold the All-Russian Spartakiad ‘AgroLeague’ in 10 sports in three stages (within faculties, between faculties and between agrarian universities) with coverage of more than 5 thousand students at each stage. The participation of all 44 agrarian universities from 38 regions of Russia is planned in the Spartakiad ‘AgroLeague.’ The 10 sports should include: basketball, volleyball, freestyle wrestling, Greco-Roman wrestling, Dota 2, athletics, GTO all-around, table tennis, futsal and chess. The basis of the assessment system should be the rating of agrarian universities, which will include: % of student-participants from the total number of full-time students, media coverage, availability of video/photo reports, attraction of partners from the agro-industrial complex, number of sports conducted.

Conclusions. The main trends in the development of student sport in agrarian universities until 2030 will be: the introduction of a mandatory set of competitions in key sports included in the AgroLeagues; the inclusion of agrarian universities in the projects of the



RSSS and ASSK Russia; the creation of student sports clubs in 100% of universities; the creation of a long-term plan for the sporting life of students until 2030; partnerships with local agro-industrial complexes for participation in events outside universities, ambassadorship for organisations and enterprises; the formation of a community of agro-industrial complex and student sport leaders; the use of digital technologies for organising events in the media space and social networks; the search for sources of financing, and others.

As the main mechanism for developing student sport, it is proposed to create AgroLeagues within the structure of universities and to hold the All-Russian Spartakiad 'AgroLeague' in 10 sports in several stages.

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Financial mechanisms and economic effects of sports in modern Russia

UDC 338.47:796



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Abstract

Objective of the study is to identify the financial mechanisms and economic effects of the functioning of sport in modern Russia.

Methods and structure of the study. The research was carried out on the basis of a systematic approach using economic-statistical methods, analysis of official data from the Ministry of Sport of the Russian Federation, federal budget reports and market indicators of the fitness industry for the period 2019–2025.

Results and conclusions. The economic significance of sport manifests through multiple mechanisms: the generation of direct revenues from paid services, the provision of jobs in related industries (tourism, retail, media), the influence on labour productivity through improving public health, as well as social effects associated with the prevention of socially significant diseases. Thus, the objective of this study is a comprehensive analysis of the economics of sport as part of the service sector and the disclosure of the mechanisms of functioning of commercial and non-commercial aspects of sporting activities in Russia [6]. Sport in Russia functions as a multi-level economic system in which state investments in non-commercial sport and support for youth programmes create the foundation for the development of the commercial sports industry. This interaction generates both direct economic effects (job creation, tax revenues) and significant indirect and social effects (improvement of public health, reduction of socially negative phenomena and development of human capital).

Keywords: *economics of sport, service sector, commercial sport, state financing, fitness industry.*

Introduction. Sport in the modern economy represents a complex and multifaceted service sector, functioning simultaneously in commercial and non-commercial segments. In the Russian Federation, sport and physical culture are regarded as strategically important directions of societal development, contributing not only to the improvement of public health but also to the generation of significant economic effects [1, 2]. According to data from the Ministry of Sport of the Russian Federation [11], in 2024, 80.452 million people systematically engage in sport, constituting 60.3% of the population aged 3 to 9 years, thereby creating prerequisites for the development of a diversified sports industry through such population involvement.

Objective of the study is to identify the financial mechanisms and economic effects of the functioning of sport in modern Russia.

Methods and structure of the study. The research was carried out on the basis of a systematic approach using economic-statistical methods, analysis of official data from the Ministry of Sport of the Russian Federation, federal budget reports and market indicators of the fitness industry for the period 2019–2025. Methods of comparative analysis of the commercial and non-commercial segments of sport were used, as well as cause-and-effect analysis for assessing the interrelationships between state support and the development of the sports industry. The information base comprised data from sports leagues, analytical portals and open sources, which ensured the representativeness of the conclusions.

Results of the study and discussion. The economic significance of sport manifests through multiple mechanisms: the generation of direct revenues from



paid services, the provision of jobs in related industries (tourism, retail, media), the influence on labour productivity through improving public health, as well as social effects associated with the prevention of socially significant diseases. Thus, the objective of this study is a comprehensive analysis of the economics of sport as part of the service sector and the disclosure of the mechanisms of functioning of commercial and non-commercial aspects of sporting activities in Russia [6].

Sport in the system of Russia's national economy occupies a dual position, functioning simultaneously as a producer of services (physical culture and health-improving services, sports events) and as an active consumer of material resources, since the modern sports industry largely integrates both the production of, for example, sports equipment and clothing, and training, organisation of sports events, medical equipment, etc. [12]

At the macroeconomic level, sport acts as a factor influencing economic growth and the creation of new jobs. In 2024, the number of employees of organisations working in the field of sport exceeded 412,900 people [8], thus indicating the significant potential of the industry as a source of employment. State support for sport in Russia is carried out through the federal budget, budgets of the subjects of the Russian Federation and municipal budgets. Total expenditures of the Ministry of Sport on physical culture and sport in 2024 amounted to 781.3 billion roubles, of which 696.3 billion roubles came from budgetary funds [4].

The structure of state expenditures includes: employee salaries (346.5 billion roubles in 2024), construction and reconstruction of sports facilities (65.6 billion roubles), organisation of sports events (51.6 billion roubles) [8]. It is noteworthy that with an increase in the number of employees in the sphere of physical culture and sport by 5,400 people, expenditures on their salaries decreased by 93 billion roubles [4], which indicates structural changes in labour remuneration and a possible decrease in the average salary in the industry.

The federal programme "Sport – a Way of Life" [8] within the framework of the national project "Demography" was aimed at achieving the target indicator: increasing the share of the population systematically engaged in physical culture and sport to 70% by 2030. More than 140 billion roubles from the federal budget have been allocated to the project since 2019 [9].

Commercial sport in Russia generates revenues from four main sources: broadcasting rights, sponsor-

ship, ticket sales and goods/services bearing the logos of sports clubs and federations. Using the example of the Russian Premier League (RPL) in football, a typical structure of commercial financing of professional sport is visible. In the 2022–2023 season, RPL commercial contracts brought 10.6 billion roubles, of which the largest share comprised broadcasting rights (7.7 billion roubles from Gazprom-Media), sponsorship contracts (2.76 billion roubles from the bookmaker company Winline) and title sponsorship (720 million roubles from the MIR payment system) [5]. After deducting organisational expenses, more than 9 billion roubles are distributed among 16 clubs [5, 15].

Interestingly, the fitness sector represents the fastest-growing segment of commercial sport in Russia. By the end of the first quarter of 2025, the fitness services market volume reached 79.7 billion roubles, which is 25.5% higher than the indicator for the corresponding period of 2024 [14]. Over five years (2019–2024), fitness industry turnover grew by 106.1%, and the number of transactions increased by 157.2% [3].

The dynamics of the online market for sports services should also be noted. Over five years, online turnover grew almost fourfold, despite the fact that the average receipt fell by 39.7% (from 4,275 roubles to 2,577 roubles) [3]. The digitalisation of the sports industry created opportunities for providing services with substantially lower costs, enabling a reduction in the price for the end consumer. Nevertheless, despite the decrease in the average receipt, 17.7 million people engage in sport on a paid basis [11], which is 1.1 million more than in 2023, and the consumer group represents the economically active population with above-average incomes, residing mainly in large cities and having access to various sports infrastructure.

The non-commercial segment of sporting activity is traditionally viewed as a source of public goods that the market, by its nature, is unable to effectively provide. Sport for all, youth sport, sport for people with disabilities – these are all directions in which the state plays a dominant role as financier and organiser. For example, the number of children and adolescents aged 6 to 15 actively participating in sports events constitutes 41.2% of the total number in this age group [8]. The state in this regard supports 1,418 sports non-commercial organisations (SONKOs) out of 3,887 registered in the country, providing them with grants and subsidies for the development of youth sport, sport for people with disabilities and adaptive sport [10].



Despite the fact that the socio-economic effects of the non-commercial segment of physical culture and sport cannot be directly monetarily assessed, they nevertheless exert a substantial influence on the economic system. For example, the improvement of the physical condition and health of the population increases labour productivity and reduces healthcare expenditures. According to estimates, every rouble invested in sport generates no less than 10 roubles of revenue in related spheres (industry, agriculture, healthcare) in the medium term [2]. In addition, physical activity, especially among youth, serves as prevention of alcoholism, drug addiction and criminal offences. According to sociological research, regular sports practice correlates with lower crime rates among youth [6].

As a consequence, commercial and non-commercial sport in Russia function in a mode of complex interaction, including both elements of cooperation and elements of competition. At one level, commercial organisations (sports clubs and fitness centres) create demand for sports goods and services, develop infrastructure and contribute to the popularisation of a healthy lifestyle. At another level, they compete with state and municipal sports institutions for attracting consumers and financial resources [1, 2]. It is interesting to note that professional commercial sport (football, hockey, basketball, etc.) largely depends on the mass sports base provided by state financing and non-commercial organisations. Without a developed system of youth sports training in schools and youth sports schools, professional sport could not provide itself with qualified athletes, at least at the initial stages of team recruitment [7, 13].

Conclusion. Sport in Russia functions as a multi-level economic system in which state investments in non-commercial sport and support for youth programmes create the foundation for the development of the commercial sports industry. This interaction generates both direct economic effects (job creation, tax revenues) and significant indirect and social effects (improvement of public health, reduction of socially negative phenomena and development of human capital).

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Effectiveness of applying the structure and content of the information component in the technical and tactical training of libero players

UDC 796.085



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Abstract

Objective of the study is to develop and experimentally prove the effectiveness of applying the structure and content of the information component in the technical and tactical training of libero players.

Methods and structure of the study. The pedagogical experiment was conducted with libero players participating in the Moscow Student Sports Games in volleyball 2023/2024. The qualification of the players ranged from Category I to Candidate for Master of Sport. 12 athletes took part in the experiment, who were divided into two groups – control (CG) and experimental (EG) – of 6 people each. The CG trained on the basis of the sports training programme for the sport of “volleyball” (2), while a methodology based on the identification of visual-informational images and signs in the actions of the opponent’s attacking team, as well as the identification of trigger mechanisms of the libero’s responsive actions, was introduced into the training process of the EG. Tests on physical and technical-tactical preparedness were conducted.

Results and conclusions. On the basis of the conducted research, the structure and content of the information component, preliminary and control testing of the physical and technical-tactical preparedness of libero players was carried out.

Keywords: *libero, defensive actions, information component, pedagogical experiment.*

Introduction. The article examines the effectiveness of applying the structure and content of the information component in the technical and tactical training of libero players. Preliminary and control testing of the special physical and technical-tactical preparedness of athletes of the control and experimental groups was conducted. Preliminary testing showed the absence of statistically significant differences between the groups, which indicates their initial homogeneity. After conducting the experiment, no significant differences in the indicators of special physical preparedness were identified. At the same time, the results of the control testing showed a statistically significant advantage of the experimental group across all indicators of technical-tactical preparedness ($p < 0.05$). The obtained data confirm the effectiveness of the proposed methodology for training libero players.

The leading link of competitive activity in volleyball is the confrontation between offensive and defensive actions [2]. It has been revealed [1] that volleyball at all stages of its development has a tendency towards growth in the attacking potential of teams of various qualifications, which is always higher than defence. This fact indicates that when playing in defence, the libero needs to quickly make responsive decisions and restructure their motor actions under spatial-temporal deficit, as well as under constantly changing conditions of the external environment. At present, the structure and content of the information component is insufficiently developed; in connection with this, it is necessary to develop and test a methodology for improving technical-tactical defensive actions with its application [3, 4].

Objective of the study is to develop and experimentally prove the effectiveness of applying the struc-



ture and content of the information component in the technical and tactical training of libero players.

Methods and structure of the study. The pedagogical experiment was conducted with libero players participating in the Moscow Student Sports Games in volleyball 2023/2024. The qualification of the players ranged from Category I to Candidate for Master of Sport. 12 athletes took part in the experiment, who were divided into two groups – control (CG) and experimental (EG) – of 6 people each. The CG trained on the basis of the sports training programme for the sport of “volleyball” (2), while a methodology based on the identification of visual-informational images and signs in the actions of the opponent’s attacking team, as well as the identification of trigger mechanisms of the libero’s responsive actions, was introduced into the training process of the EG. Tests on physical and technical-tactical preparedness were conducted.

Results of the study and discussion. On the basis of the conducted research, the structure and content of the information component, preliminary and control testing of the physical and technical-tactical preparedness of libero players was carried out.

Preliminary testing on special physical preparedness showed that the groups are practically homogeneous.

The results in the tests are as follows: long jump: CG – 250.4±2.14 cm, EG – 248.5±1.73 cm; 30 m run: CG – 5.34±0.10 s, EG – 5.51±0.14 s; shuttle run: CG – 10.92±0.15 s, EG – 11.10±0.09 s.

In all tests $U_{emp} > U_{cr}$ (7, 8, 7, respectively), which at $p > 0.05$ indicates the absence of significant differences.

Regarding technical-tactical preparedness, the results of the preliminary testing are presented in Table 1.

In all six tests, U_{emp} was in the range from 11.5 to 16 at a critical value of $U=5$, which at $p > 0.05$ confirms the homogeneity of the groups and a comparable initial level of technical-tactical preparedness.

Control testing of special physical preparedness did not reveal significant intergroup differences. Long jump: CG – 251.5±2.04 cm, EG – 249.8±1.84 cm; 30 m run: CG – 5.14±0.12 s, EG – 5.40±0.16 s; shuttle run: CG – 10.68±0.13 s, EG – 11.04±0.11 s. In all cases $U_{emp} > U_{cr}$ (7, 8, 7), $p > 0.05$ – significance of differences is absent. This means that physical preparation in both groups produced a comparable increase in results.

However, the results of the control testing of technical-tactical preparedness showed a substantial reduction in time in favour of the EG. The results are presented in Table 2.

Based on the data of the control testing, it can be seen that in all tests the empirical value of the Mann–Whitney test is less than the critical value ($U_{cr}=5$), which confirms the statistical significance of the identified differences at the level of $p < 0.05$.

The conducted tests showed that the libero players are at the same level in physical parameters after the

Table 1. Results of testing the technical-tactical defensive actions of the libero relative to second passes before the experiment (sec)

Groups	Test results					
	Quick 4	Quick 2	Quick 6	Zone 4	Zone 2	Zone 6
CG	1.208±0.037	1.163±0.031	1.167±0.034	1.21±0.035	1.33±0.089	1.13±0.38
EG	1.206±0.026	1.168±0.028	1.17±0.032	1.23±0.036	1.28±0.014	1.14±0.048
Significance of differences ($U_{cr} = 5$)	$U_{emp}=16$ $p > 0.05$	$U_{emp}=15$ $p > 0.05$	$U_{emp}=16$ $p > 0.05$	$U_{emp}=12.5$ $p > 0.05$	$U_{emp}=11.5$ $p > 0.05$	$U_{emp}=16$ $p > 0.05$

Table 2. Results of testing the technical-tactical defensive actions of the libero relative to second passes after the experiment (sec)

Groups	Test results					
	Quick 4	Quick 2	Quick 6	Zone 4	Zone 2	Zone 6
CG	1.195±0.026	1.148±0.045	1.165±0.071	1.205±0.04	1.303±0.013	1.13±0.012
EG	1.121±0.046	1.11±0.059	1.136±0.086	1.143±0.03	1.14±0.024	1.1±0.018
Significance of differences ($U_{cr} = 5$)	$U_{emp}=4$ $p < 0.05$	$U_{emp}=5$ $p < 0.05$	$U_{emp}=5$ $p < 0.05$	$U_{emp}=2.5$ $p < 0.05$	$U_{emp}=0$ $p < 0.05$	$U_{emp}=3$ $p < 0.05$



Table 3. Comparison of intergroup shifts after conducting the experiment (%)

Groups	Test results					
	Quick 4 (sec)	Quick 2 (sec)	Quick 6 (sec)	Zone 4 (sec)	Zone 2 (sec)	Zone 6 (sec)
CG	1.07	1.3	0.17	0.41	2	0
EG	7	5	2.9	7.1	10.9	3.5
Shift	+5.93	+3.7	+2.73	+6.69	+8.9	+3.5

conducted experiment; however, in technical-tactical preparedness there are evident changes in favour of the EG. The reduction in time for performing technical-tactical actions in defence shows that the libero players began to analyse the actions of the setter faster and to make responsive actions for movement in defence depending on the direction of the pass.

To identify the effectiveness of our methodology, let us compare the shifts between the groups after conducting the experiment. The results are presented in Table 3.

Of particular informativeness is the analysis of intra-group and intergroup shifts. In the control group, the improvement of results across various tests amounted to from 0.17% to 2.0%. In the experimental group, the shifts are substantially higher: from 2.9% to 10.9%. Intergroup comparison of shifts showed superiority towards the EG: "quick-4": difference of shifts +5.93%; "quick-2": +3.7%; "quick-6": +2.73%; "zone-4": +6.69%; "zone-2": +8.9%; "zone-6": +3.5%. The obtained data indicate that the proposed methodology of applying the structure and content of the information component in the technical-tactical training of libero players is more effective than the traditional one.

Conclusions. As a result of the conducted research, it was established that the application of the structure and content of the information component yields an insignificant increase in the physical preparedness of players; however, in technical-tactical

preparedness, before and after the experiment, substantial shifts in favour of the experimental group are observed across all tests.

The proposed methodology is recommended for introduction into the training process of student volleyball teams, as well as into the preparation programmes of libero athletes at the sports mastery improvement stage.

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Technology for preparing fundamental scientific research works in sports pedagogy

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Abstract

Objective of the study is the substantiation of a comprehensive hypothetico-deductive model of fundamental research in sports pedagogy.

Methods and structure of the study. The research was carried out using the method of hypothetico-deductive profile-applied modelling, as well as methods of document analysis (doctoral dissertations in pedagogy over the past 45 years) and the method of expert assessment with the participation of 11 lecturers from various Moscow universities holding the academic degrees of candidates and doctors of the social-humanitarian sciences block.

Results and conclusions. The comprehensive hypothetico-deductive model developed within the framework of the study makes it possible to overcome the limitations of narrow-profile approaches. The model provides a logically verified trajectory of cognitive movement from an intuitive image through the deductive derivation of concepts, field empirical processing, analytical interpretation to the creation and experimental verification of pedagogical technology.

Thus, the application of the proposed model of comprehensive hypothetico-deductive research in sports pedagogy contributes to the generation of reliable knowledge, corresponds to the modern stage of integrative development of science and education, and also makes it possible to prepare scientific qualification works that meet the requirements of interdisciplinarity and practical effectiveness.

Keywords: *differentiation, integration, comprehensiveness, hypothetico-deductive theory, concrete sociological research, model.*

Introduction. The period from the late 19th to the early 20th century was marked by the development of the comprehensive character of social-humanitarian and natural-scientific knowledge (the best domestic example of this pattern was the society of M.M. Kovalevsky). By the mid-20th century, in foreign, and subsequently in domestic science, the dynamics of alternating dominance of the processes of differentiation and integration of scientific-disciplinary knowledge intensified.

This dynamic, with the predominant prevalence of differentiation processes, reached such rates and volumes that attempts to somehow construct the logic of evolution and continuity of differentiating sciences became extremely difficult [1, 2, 10, 11]. The increasingly narrow-profile character of such theories hindered scientific discoveries and did not allow "breakthroughs" into new areas of knowledge. Therefore, it is not by chance that Albert Einstein called these theories "one-eyed freaks," and UNESCO addressed the world's scientists with an appeal to move away from the creation of ever more descriptive theories towards the development of "breakthrough"

hypothetico-deductive theories [8, 9]. The natural and expected negative consequences of the differentiation of scientific knowledge were both the fragmentation, discreteness, and atomisation of the scientific community, as well as the avalanche-like growing number of conceptual contradictions and competition between its fragmented parts [4]. Considering that differentiation processes did not cease even within these parts, such disciplines as pedagogy and psychology increasingly began to be called not sciences, but science-arts [5].

As a natural reaction to the dead-end narrow-profile character of a number of descriptive scientific theories and educational disciplines (including those that had prevailed in sports science), from the 1970s the processes of integration of scientific-disciplinary knowledge and the return to the requirement of its comprehensiveness began to gain the upper hand. In the sciences of physical culture and sport, this pattern was reflected, for example, in the development of the general theory of physical culture and the integrative theory of sport by L.P. Matveev [6], in the ontokinesiology of V.K. Balsevich [3], in the



concept of types and kinds of psychophysical activity by V.K. Balsevich and A.A. Peredelskiy [8].

In sports pedagogy, fundamental profile-applied research of a comprehensive character has appeared, for example, in the field of the formation and development of the world culture of football, martial arts and combat sports [7, 8].

Thus, the theoretical-methodological and methodological prerequisites were created for designing models of comprehensive hypothetico-deductive research on the basis of sports pedagogy, including those intended for application in the preparation of scientific qualification works of various levels.

Objective of the study is the substantiation of a comprehensive hypothetico-deductive model of fundamental research in sports pedagogy.

Methods and structure of the study. The scientific research was organised on the basis of using the method of hypothetico-deductive profile-applied modelling, as well as methods of document analysis (doctoral dissertations in applied pedagogy over the past 45 years) and the method of expert assessment with the participation of 11 lecturers from various Moscow universities holding the academic degrees of candidates and doctors of the social-humanitarian sciences block.

Results of the study and discussion. It was revealed that since the early 1980s, pedagogy has increasingly been interpreted as a science-art, admitting various conceptual interpretations of similar or analogous topics depending on which scientific-educational disciplines were involved in the selection of theoretical-methodological foundations, as well as in the process of the field stage of obtaining, and further, in the process of processing and interpreting primary and secondary empirical material. Accordingly, pedagogy increasingly began to be viewed as a complex of profile-applied pedagogical theories. Among the most frequently engaged non-pedagogical disciplines of the social-humanitarian block, in descending order of mention frequency, are: philosophy, psychology, history, sociology, ethnography, ethnology, anthropology. On the part of the domestic scientific-educational community, the level of expectations and demand for comprehensive, integrative research in pedagogy, especially applied profiles, is growing at an accelerating pace (compared with the relatively low rate of increase in the number of such studies). Nevertheless, over the past 45 years, a certain, albeit not very significant, positive dynamic of increase in the number of doctoral studies in pedagogy of a no longer narrow-profile but broader comprehensive character has also been observed. In such comprehensive pedagogical studies,

the pedagogical part itself serves as the concluding and unifying link, the final phase of the entire study, in which all non-pedagogical results are considered as preliminary source materials interpreted in the context of one or another pedagogical project.

For the implementation of the indicated standard comprehensive pedagogical project, a corresponding model of hypothetico-deductive theoretical-empirical research was developed, incorporating practically all the main general scientific theoretical and empirical methods. The model has four development zones: theoretical-hypothetical, theoretical-deductive, empirical, practical. The dialectical trajectory of the research process has six vectors:

- cognitive movement from an intuitively "condensed" contemplative image to a developed theoretical concept;
- transition from a concept to the development of a full-fledged research programme with working tools;
- conducting the field stage of research with obtaining primary (secondary) empirical information;
- processing the indicated information with the development of empirical data;
- preparation of an analytical report for creating a pedagogical project;
- development of a pedagogical project and its experimental practical verification.

Technologically, such a model of comprehensive pedagogical research is implemented in 12 stages.

Stage 1 – search and figurative-associative "reading", philosophical theoretical-methodological analysis and typification (classification) of foreign and/or domestic precedents encountered in world history of the existence of typical problematic socio-conflictual situations that have an outlet to the purposeful formation (education) of personality or to purposeful influence on a specific social group.

Stage 2 – tracking and selection of those historical (religious or secular) narratives that, as a final or intermediate result, were accompanied by facts of pedagogical influence on the basis of individual or group internalisation of ideological programmes with subsequent formation of intellectual-spiritual and psychophysical parameters (features) of a value-orientational character.

Stage 3 – on the basis of analysis of historical-archival and scientific-publication (archaeological, ethnographic, ethnological, anthropological) materials, investigation of a number of cause-and-effect dependencies in the formation of methodologies and technologies of systematic pedagogical influence.

Stage 4 – detailed examination of the specificity, sequence and continuity of the formation of the indicated methodologies and technologies with the aim of identifying



ing their strengths and weaknesses, as well as establishing the core, quintessence of features of their most effective formative psychological-pedagogical influence.

Stage 5 – on the basis of advancing a set of conceptually interconnected axioms, i.e. positions accepted as intuitively clear, – formulation of specific hypotheses and corresponding research tasks.

Stage 6 – implementation of deductive logical-linguistic derivation (primary logical interpretation and operationalisation) of the main concepts of the research with the aim of cause-and-effect deployment of the scientific thesaurus of the research.

Stage 7 – conducting subsequent programme operations (description of the general population of information sources, substantiation of methods and construction of a sampling model, compilation of a tool verification table), the result of which is a specific field research toolkit using justifiably selected scientific-empirical methods.

Stage 8 – conducting field research and all programme-prescribed operations and procedures for processing primary empirical information: checking for completeness and quality of filling, screening, refinement, closing of open and semi-closed positions, continuous or block coding, actual processing by internal and external distribution series).

Stage 9 – conducting the operation of scientific interpretation of obtained empirical data by placing them in a theoretical coordinate system, the role of which is performed by specific hypotheses and tasks with the aim of forming analytical indicator-parameters.

Stage 10 – on the basis of obtained indicators, formation of a detailed analytical report with conclusions and recommendations for creating an experimental pedagogical technology.

Stage 11 – development of pedagogical technology and its socio-pedagogical (or psychological-pedagogical) experimental verification within the timeframes established for the indicated types of pedagogical experiment.

Stage 12 – based on the results of the conducted experiment, carrying out substantiated correction and refinement of the experimental pedagogical technology with its subsequent practical implementation, replication, legitimisation and, possibly, institutionalisation.

Conclusions. The comprehensive hypothetico-deductive model developed within the framework of the study makes it possible to overcome the limitations of narrow-profile approaches. The model provides a logically verified trajectory of cognitive movement from an intuitive image through the deductive derivation of concepts, field empirical processing, analytical interpretation to the creation and experimental verification of pedagogical technology.

Thus, the application of the proposed model of comprehensive hypothetico-deductive research in sports pedagogy contributes to the generation of reliable knowledge, corresponds to the modern stage of integrative development of science and education, and also makes it possible to prepare scientific qualification works that meet the requirements of interdisciplinarity and practical effectiveness.

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The role of physical activity in various forms of practice of amateur and professional chess players

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Abstract

Objective of the study is to identify the dependence of physical activity in various forms on chess practice at the professional and amateur levels.

Methods and structure of the study. To study the influence of chess practice on the physical activity of young people, a qualitative sociological study was conducted using the in-depth interview method, in which 20 people aged 18 to 35 participated. The interview guide was compiled according to the following research questions: the significance of chess in the informant's life, the main types of physical activity of chess players, preferred sports, the significance of physical education for chess as a sport, as a hobby and leisure activity. The interpretation of results was carried out using the method of progressive approximation and illustration.

Results and conclusions. It was established that amateur chess players do not associate their physical activity with their interest in chess; on the contrary, professionals and semi-professionals approach physical activity with particular attention, which has a positive effect not only on their general health but also allows them to properly recover after intellectual work, as well as to train qualities significant for chess sport: concentration, endurance, stress resistance. The significance of combining physical and intellectual development is explicated in the emergence of hybrid sports, such as, for example, chess boxing, which combines a game of chess and a boxing bout.

Keywords: chess, intellectual sport, professionals, amateur chess players, leisure and physical activity, the influence of chess on the development of youth and children.

Introduction. Chess is traditionally considered an intellectual game requiring a high level of concentration, strategic thinking and the ability to analyse the situation. In recent years, not only in Russia but throughout the world, the popularity of chess among the population has been gradually growing. According to the results of 2024, the Ministry of Sport of the Russian Federation provided statistics according to which "chess ranked ninth among the most popular sports in 2024 – 1,101,642 people play chess" [4]. The Ministry of Sport of the Russian Federation presented a programme for the development of chess sport in the country for the period from 2025 to 2028, aimed primarily at forming a reserve of professional athletes, holding annual chess tournaments, and introducing chess in higher education institutions ("Chess in Universities") [4]. And this is not

by chance. Many scientists write about the positive influence of chess on the cognitive development of children and youth [1].

Chess is analysed by scientists from various angles and perspectives: from the standpoint of games and leisure (Ezri G.K.) [5], education and development of personal skills (Smetana V.V.) [3], as well as professional sport (Aleksandrov S.G., Dzhaginyan E.M., Girskeya K.A., Shevchenko A.S. [1]). The growth of chess popularity among youth is studied by Pronin E.A. and Abramov D.N. [2] and others. Of greatest interest is the study of the influence of chess not on individual aspects of personality, but on its comprehensive development, both intellectual and physical.

Objective of the study is to identify the dependence of physical activity in various forms on chess practice at the professional and amateur levels.



Methods and structure of the study. To study the influence of chess practice on the physical activity of young people, a qualitative sociological study was conducted using the in-depth interview method, in which 20 people aged 18 to 35 participated. The interview guide was compiled according to the following research questions: the significance of chess in the informant's life, the main types of physical activity of chess players, preferred sports, the significance of physical education for chess as a sport, as a hobby and leisure activity. The interpretation of results was carried out using the method of progressive approximation and illustration.

Results of the study and discussion. Professional development in chess sport and views on what it should be differ depending on the current level of athletes and their ultimate goals. Interpretation of in-depth interview data allows us to say that the attitude towards chess among modern youth can be divided into three directions: chess as a form of leisure, as a hobby and as a professional activity. Respondents who started playing chess several years ago classify this type of activity as leisure, combining "the game" with reading, walks, drawing, etc. In this case, amateur respondents do not strive to obtain a sports ranking, further development and speak about it as follows: *"The main thing for me is still the pleasure from the process itself"* (female, 24 years, amateur); *"I hope that I will be able to slightly improve my level, or at least to satisfy my self-esteem"* (female, 26 years, amateur).

Another group of respondents, let us call them conventionally "semi-professionals", are those for whom chess is a hobby, a favourite pursuit, but not related to their professional activity. They play chess not only for pleasure, but somewhat for development and improving their level of play: *"I would like to achieve serious progress, rise to the first rank"* (female, 29 years, semi-prof.); *"I dream of growing to a candidate for master of sport"* (male, 35 years, semi-prof.).

And finally, professionals who "live" in their sport-ing practices: *"Oh, chess is my love, I have been playing since childhood, for a very long time"* (female, 19 years, prof.). For them, chess is not only sport and their professional activity, but also a social space for making acquaintances, communication, social interaction: *"I came to the conclusion that chess is more about people, communication, feelings than just about winning"* (male, 31 years, prof.).

Engaging in an intellectual, or rather passive sport actualises the study of the role and methods of rest

for chess players, which is recognised as a significant recovery process: *"The more frequent and intensive chess practice becomes, the more important the ability to rest and switch to other types of activity becomes"* (female, 33 years, prof.). As the results of the study showed, so-called "amateurs" find in chess a way to distract from daily affairs, an opportunity to diversify their leisure practices. Therefore, playing chess for them is a way to rest and switch: *"...About two to four hours a week I play just for pleasure... it helps to switch and distract from everyday routine"* (male, 24 years, amateur). Conversation with the research participants "professionals" and "semi-professionals" showed that chess practice is almost always accompanied by some additional activity: travel, playing musical instruments, but informants ascribe particular significance to physical activity. Interpretation of the research participants' statements allows us to identify several functions that physical education and sport perform for semi-professional and professional chess players.

Firstly, a change of surroundings. Chess practice involves prolonged stay in a closed room and in a seated position, which actualises the significance of physical activity outdoors: *"I prefer active types of recreation: football, cycling, hiking in the forest"* (male, 27 years, amateur), *"Walking, cycling in warm weather, sometimes I visit the pool"* (male, 34 years, professional).

Secondly, emotional release, that is, obtaining positive emotions, which allows one to relieve tension: *"I do dancing and attend group fitness classes"* (female, 23 years, amateur); *"I love team sports, they are excellent for recharging"* (male, 29 years, professional).

Thirdly, maintaining muscle tone, which, in the opinion of the research participants, has a positive effect on both general well-being and develops endurance, stimulates brain activity, provides vigour and lightness: *"Nordic walking, outdoor walks – all of this strengthens the immune system and provides the necessary vigour. Every morning I charge myself with energy and am ready to conquer the peaks of the chess Olympus"* (female, 32 years, semi-professional); *"After all, fresh air and movement are beneficial not only for the body but also for the brain"* (male, 20 years, semi-professional).

Fourthly, physical activity allows one to train significant skills for professional development in chess, such as concentration, emotional control, psychological resilience. It is not by chance that one of the most



popular sports directions among female chess players is yoga, which is described by informants as follows: *"I do yoga, and yoga is, of course, also sport, but it is a kind of sport where great attention is also paid to concentration, relaxation, meditation"* (female, 29 years, professional); *"To be honest, I have never been involved in professional sport, but I regularly attend yoga. Physical activity... helps to reduce anxiety before important games"* (female, 18 years, semi-professional); *"Yoga is especially beneficial as it helps to develop body flexibility, strengthens back and neck muscles, reduces stress and fatigue"* (female, 31 years, professional). Male chess players train other significant qualities for effective play: reaction speed, unconventional thinking, resourcefulness, intuition: *"I actively play mini-football and table tennis. Both directions require quick assessment of the situation, instantaneous reactions and the ability to orientate in space"* (male, 29 years, professional); *"My main hobby is cycling. Cycling helps to relax and clear the head after intense working days and difficult games"* (male, 23 years, semi-professional); *"Main sports preferences are athletics and Nordic walking. Daily small training sessions keep muscles in tone, the heart healthy, which has a beneficial effect on the overall brain performance"* (male, 28 years, semi-professional).

Conclusions. Based on the results of the study, it can be concluded that amateur chess players do not associate their physical activity with their interest in chess; on the contrary, professionals and semi-professionals approach physical activity with particular attention, which has a positive effect not only on their general health but also allows them to properly

recover after intellectual work, as well as to train qualities significant for chess sport: concentration, endurance, stress resistance. The significance of combining physical and intellectual development is explicated in the emergence of hybrid sports, such as, for example, chess boxing, which combines a game of chess and a boxing bout.

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A study of sensorimotor reactions and vertical stability of highly qualified female athletes in aesthetic gymnastics

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Introduction. Aesthetic gymnastics is a team sport that requires synchronicity, continuity of movement, and a high level of physical development [2]. Competitive combinations include balances, jumps, waves, and lifts, placing increased demands on sensorimotor coordination and balance [1].

Objective of the study is to determine the level of vertical stability and sensorimotor reactions (simple and complex) in masters of sports in aesthetic gymnastics [3].

Methods and structure of the study. The study was conducted at the Innovation Center of the Russian Olympic Committee (ROC) in Kislovodsk. Eight athletes from the Amouage team, members of the Russian national team, participated. The following were used: 1. The Psychophysiolgist UPFT-1/30 device for simple visual-motor reaction (SVMR) and reaction to a moving object; 2. The BlazeBod device for complex reaction to a light combination; 3. The Stabilan 01-2 stabiloanalyzer for assessing vertical stability in static and moving positions.

Results of the study and discussion. The athletes' sensorimotor response performance was determined using three tests: the simple visual-motor reaction (SVMR), the complex visual-motor reaction to a combination of symbols (CVMR), and the moving object reaction test. The average simple reaction time was 220.63 ms, with a variability of 42.25 ms (average performance). The average number of errors was one. The complex reaction showed an average time of 711.50 ms, with one error. In the moving object reaction test, accuracy was 59.25% (average), and the nervous system balance coefficient was 0.89%, indicating a predominance of excitation over inhibition. In

a static position with eyes open, the quality of balance function (QBF) was 85.88% (good), with eyes closed – 68.63% (average), in the "Target" test – 70.75% (average). When assessing stability in motion, the area of the movement zone was 20676.75 mm, the ratio of "forward-backward" deviations was 1.52 (poor), "right-left" – 1.02 (normal).

Conclusions. 1. Highly skilled gymnasts demonstrate an average level of CNS activation (RT 220.63 ms, SRT 711.50 ms). 2. The reaction to a moving object revealed an average level of accuracy (59.25%) and a predominance of excitation processes (balance coefficient 0.89%). 3. Static vertical stability was good to average (up to 85.88%). 4. Dynamic vertical stability (in motion) was poor in the frontal plane (1.52 with a norm of <1.0), requiring additional training.

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The influence of volleyball on the motivational attitudes of rural students through supplementary education

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Introduction. Volleyball, as a team sport, represents an attractive and accessible form of physical activity capable of involving rural students in regular training and competitions. Despite the obvious benefits of physical activity, there is insufficient research devoted to the influence of specific sports, such as volleyball, on the motivational attitudes of rural students. The study was conducted taking into account the specifics of rural areas. For example, there were infrastructural limitations. At the school where the study was conducted, there were no specialised sports halls, equipment or qualified volleyball coaches. Rural schoolchildren and researchers lived far from each other, which complicated the organisation of regular training sessions and, accordingly, the conduct of research requiring long-term observation.

Objective of the study is to identify and analyse the influence of volleyball practice on the motivational attitudes of rural students.

Methods and structure of the study. The study was conducted on the basis of the Municipal General Education Budgetary Institution "Suzanovo Secondary School" of the Orenburg Region during 2024. Schoolchildren of grades 7–8 took part in the experiment, combined into an experimental group (EG) and a control group (CG) of fifteen people each. At the same time, the EG attended supplementary classes (a sports section), while the CG did not (they played volleyball during physical education classes).

Methodological support for the schoolchildren was provided by lecturers of the I.I. Mechnikov North-Western State Medical University. The following were

applied: questionnaires ("Study of learning motivation at school" by M.R. Ginzburg), testing (to assess the level of physical activity) and pedagogical observation (to record behavioural patterns).

Results of the study and discussion. The students attended supplementary volleyball classes. The subsequent analysis of empirical data made it possible to identify the influence of supplementary volleyball classes (physical activity) on the motivational attitudes of students: enjoyment of the game (34%), being part of a team (26%), approval of those around them (18%), pursuit of personal goals (22%).

The influence of volleyball on the motivation of the CG is insignificant. The two groups intersected during physical education lessons, where they played volleyball together. The main motivation, in this case, for the two groups was obtaining a positive grade in the subject of physical education.

Conclusion. Thus, volleyball, as a team sport, possesses unique potential for increasing the physical activity of rural schoolchildren and forming stable motivational attitudes in them. Regular volleyball classes form a habit of discipline and self-control. Successes in volleyball, even if small, increase self-esteem and confidence in one's own abilities, which has a positive effect on learning activity and the aspiration for new knowledge.

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